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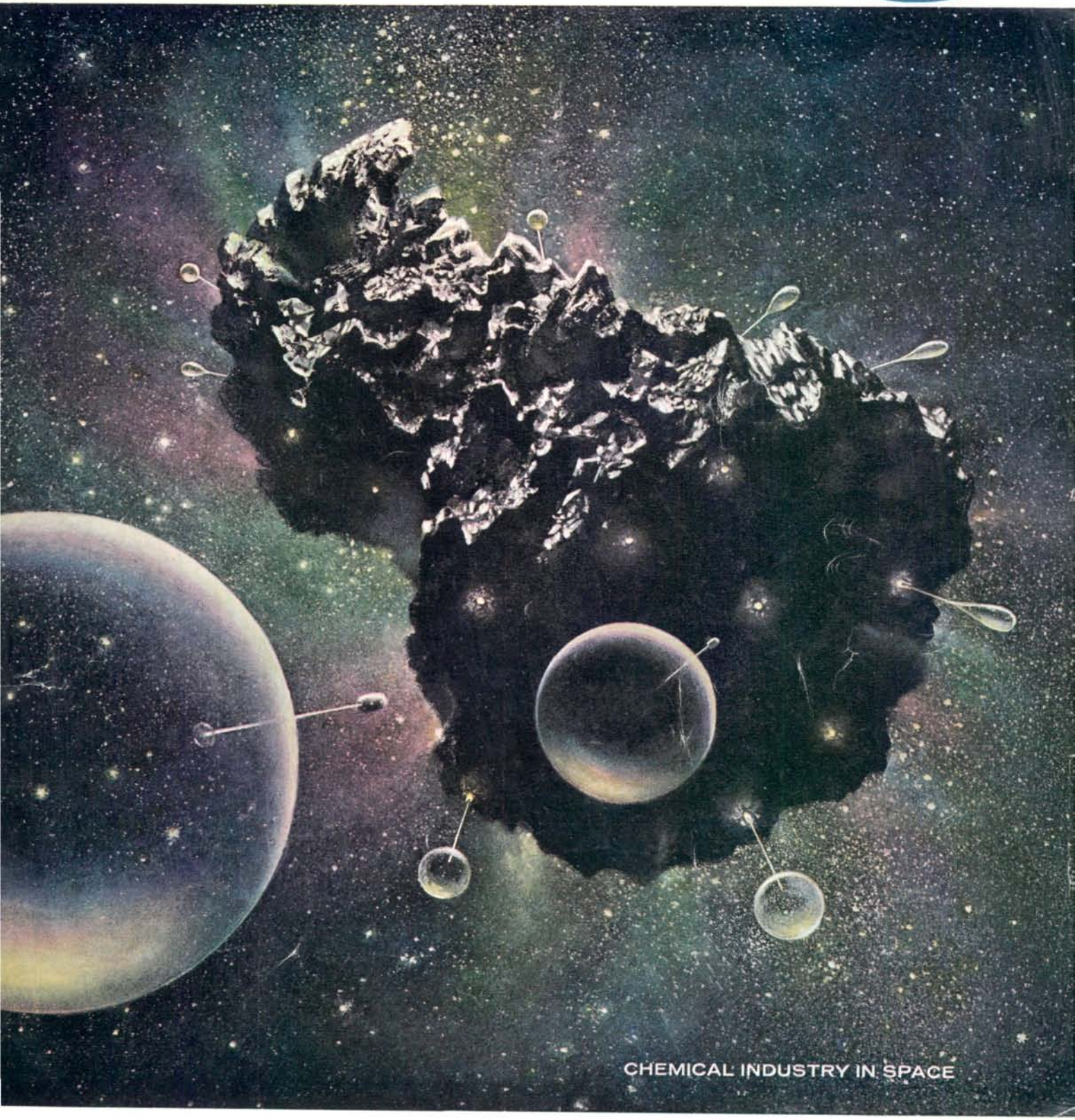

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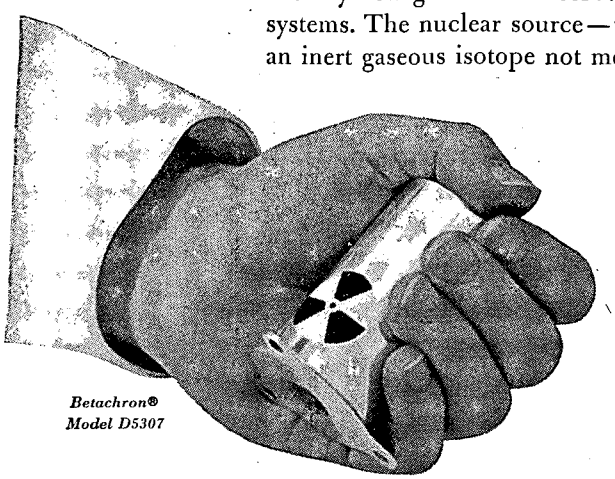

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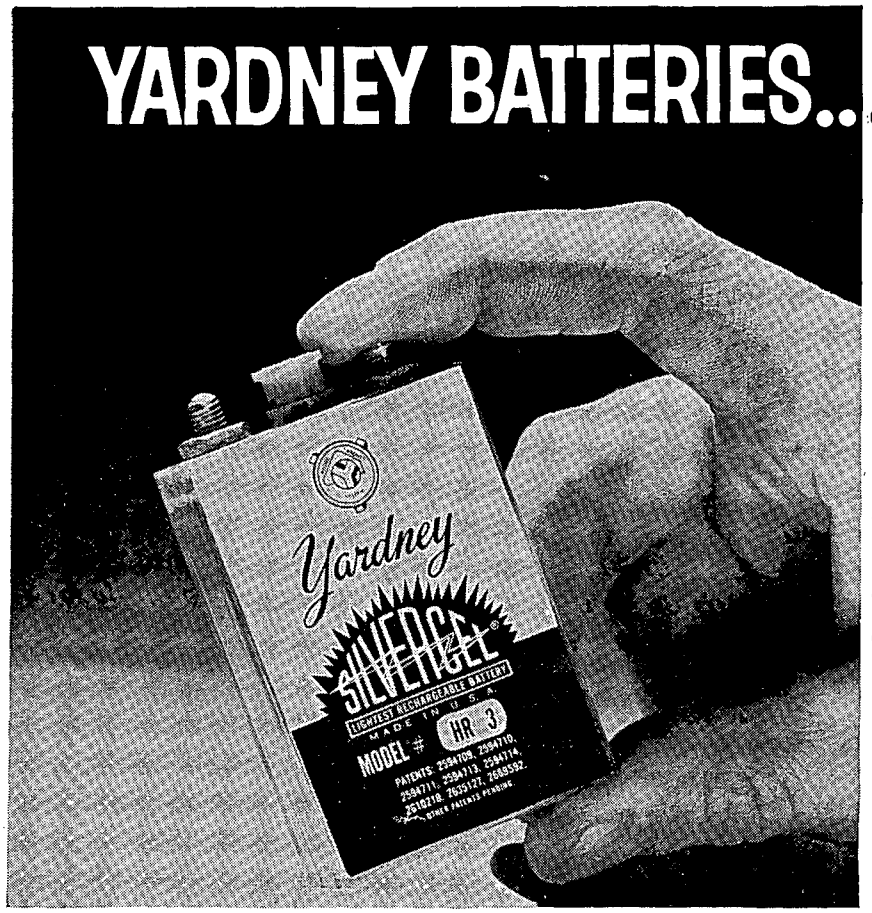

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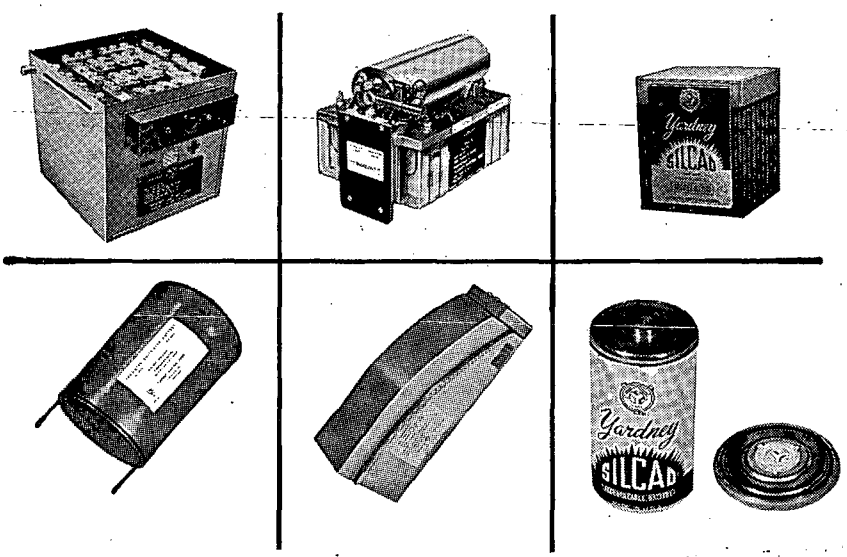

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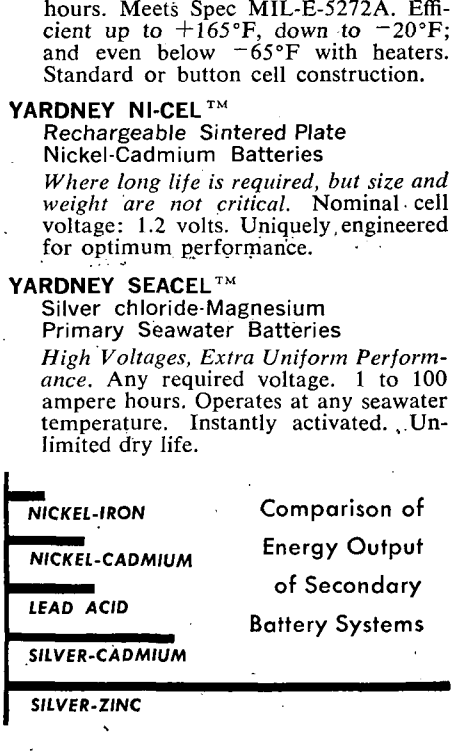

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SCIENCE FACT — SCIENCE FICTION

SCIENCE FACT

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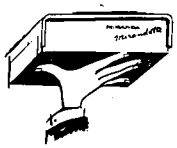

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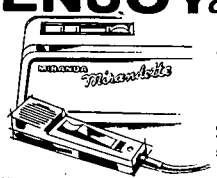

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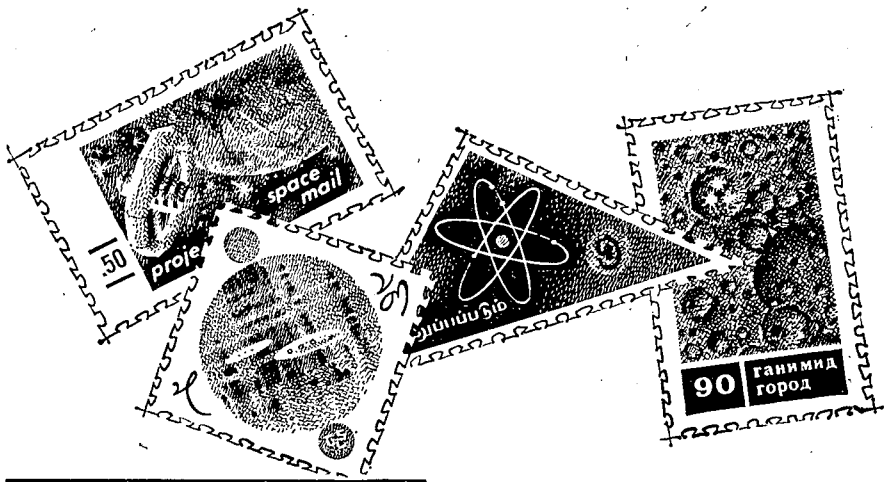

BRASS TACKS

Dear John:

As you know, for the past several years we have been working on a theory of Dynamic Systems, as set forth by Dr. W. O. Davis in the May, 1962 issue of ANALOG, and as presented at the April, 1962 meeting of the American Physical Society, in Washington, D.C., (entitled, "Some Aspects of Certain Transient Mechanical Systems," by Davis, Victory, Stine & Korff).

In the course of our investigations we have performed a number of experiments of the type suggested by Mr. Dean in his letter to ANALOG (April, 1963). It was our purpose to investigate any possible relationship between phasing, as described by Dean, and the behavior as predicted by the theory.

Unfortunately, our results do not agree with those of Mr. Dean.

Between May and August, 1961, in our laboratories, which were then located in Milford, Connecticut, we constructed a simple mechanical oscillator of the type described by Mr. Dean in his letter. This particular type of device with its counter-rotating masses is commonly used to generate oscillatory motion, and is generally known as a "Buehler Drive." Mass of the rotating weights was 1607.3gm., and the ratio of the mass of the weights to the mass of the carriage was 0.9333. The test device was driven by a ¼-inch electric drill motor, which was equipped with a 6-inch-diameter 10-pound flywheel to insure constant rate of angular rotation, thence through a universal joint, a slip joint, and another universal joint. A protractor-type dial was affixed to the front of the device, with a pointer on the shaft of the upper mass to indicate angular position of the weights. A cursor line and a scale were used to determine position of the carriage in the lateral direction. Operation was observed with the aid of a General Radio "Strobotac," and photographs of the operating device were made. A Variac adjustable autotransformer was used to control the rotational speed of the motor.

We operated the device in many tests over a four-month period, and over a speed range from 150 to 1500 rpm.

Under exactly the conditions described by Mr. Dean in his letter, the maximum phase angle observed was 3°. This was achieved at rotational speeds just below those at which the equipment was subjected to internal stresses of sufficient magnitude to produce component failure. Whenever this small leading phase angle appeared, the device started to come apart; universal joints, pins, and set screws, for example, failed, in spite of the fact that we continually increased the ruggedness of the device. The stresses were high enough to destroy 1-inch universal joints, for instance.

At lower rotational speeds, the small leading phase angle completely disappeared.

We should like to point out that there is a vast body of engineering data on rotating and oscillating ma-

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chinery, including shake tables and their driving mechanisms. Many of these devices have been carefully instrumented with precise transducers, and phase angles of the sort predicted by Mr. Dean have not been observed. As a matter of fact, a phase angle of 45° would be such a gross departure from predicted and observed behavior that (a) the phenomena would have either been well known by now, or (b) the construction and operation of such mechanisms would be nearly impossible.

It is interesting to note that ordinary slipper-type joints such as the type used by Dean and available for Boston Gear, DO NOT transmit rotary motion with constant angular velocity. An ordinary U-joint has two lobes of increasing angular velocity 180° apart. Using two U-joints, it is possible to eliminate this problem to some extent by putting the joints at 90° to one another; thus allowing the lobes of each to overlap to some extent, producing more uniform rotational motion. However, even using two U-joints, it is never possible to achieve the constant angular velocity which Dean says is mandatory. Through study of published photographs of the Dean Drive, we have noticed that Dean does not align his U-joints at all; some are 30° to each other, some are 45° to each other, et cetera, in performing our experiments, we varied the angular relationship between the joints to investigate the possibility that the large phase angle claimed by Dean might have been due to inadvertent angular alignment of his U-joints. However, we could notice no change in our observed phase angle.

The only universal joint capable of smoothly transmitting torque through an angle with constant rotational speed is the Rzeppa Joint, which is used, for example, in 4-wheel-drive vehicles.

While registering this difference of opinion and experience with Mr. Dean, we do not wish to imply that we believe that Mr. Dean's device will not work. On the contrary, one of us has carefully observed the Dean device in operation at Mr. Dean's home and be-

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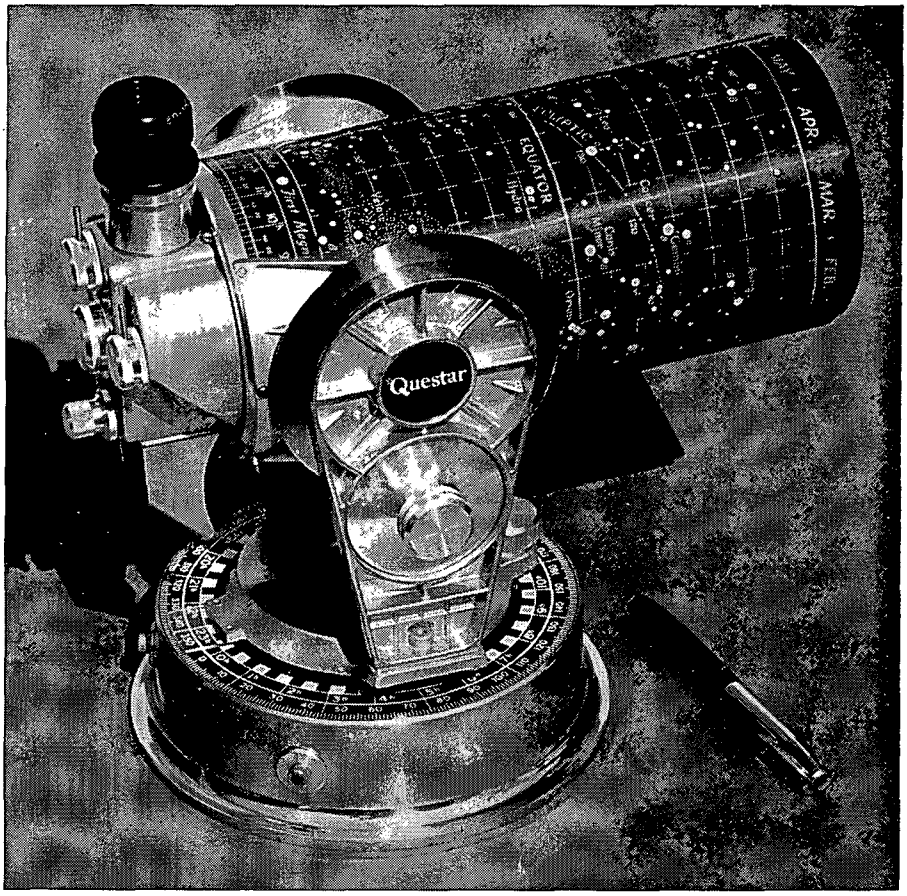

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These paragraphs open the 23-page Questar booklet which is illustrated by some astonishing photographs, showing 1- and 2-second detail, that let the instrument's high performance speak for itself. May we send you a copy? Questar costs only $995 in English fitted leather case and is sold only direct at one factory price.

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AN EDITORIAL BY
JOHN W. CAMPBELL

THE SEARCH FOR DYNAMIC STABILITY

Some twenty thousand years ago, Mankind had achieved a Utopian system of living-together. All over the Earth there were small cultural groups living in stable, harmonious cultural-systems. The system of societies then in existence had developed over a period of some 250,000 years, and tens of thousands of human generations of trial-and-error had finally produced a stable system of government, in which the individual human being was happy and content.

They had developed the perfect Totalitarian State, in which every individual lived for the state, not the state for the individual, but it was unlike modern quasi-totalitarianisms. George Orwell's "1984" or Hitler's Reich both suffered from the unfortunate fact that the breed of human beings available was not satisfactory. Both were engaged in correcting that flaw.

The ants and bees and termites have long since worked out the problem of the Totalitarian State to perfection. Notice that a Totalitarian state does *not* automatically mean that the individuals must be miserable — suppressed—victims of a cruel and tyrannical dictatorship.

An ant hill is not a dictatorship. And the individuals in the totalitarian system are not miserable nor do they feel in any way whatever that they are being cruelly suppressed. They are free to do exactly what they most want to do.

Of course . . . what they want to do is predetermined by the system before they see the light of day. They're free to do what they want all right—they're just not free to want anything else! An ant worker *couldn't* want to be a queen, by the time she's hatched.

A setter makes a wonderful bird dog . . . and wants nothing else. It can't *want* to be a shepherd, any more than a Border Collie could *want* to be a mountain-lion hunter.

Some twenty thousand years ago, Mankind had achieved Paradise, because the totalitarian state system of the ritual-taboo tribes had, in the course of some ten thousand human generations, selectively bred for a personality type that *wanted* to live in a ritual-taboo totalitarian state. Look—if that's the way you *want* things to be, then it's what makes you happy, isn't it? It's Paradise for you, isn't it?

So they died like flies, because they had no sanitation, and couldn't grow enough food, and didn't know about birth control, and their medical treatment was little better than that of the ants and bees. But they were happy. They were happy because ten thousand generations had been culled and picked over to produce a type that *was* happy in the totalitarian state system.

Let Hitler's Reich run for a thousand years, and the citizens thereof would have been made up exclusively of people who liked that nice, comfortable, reliable, secure, dependable New Order. And kangaroo rats *like* living in a desert, never getting a drink of water in their entire lives. Just because you think that's hell doesn't prove it is, does it? Not for a type bred for that specific situation, it isn't!

And look . . . who says a deer has a miserable life, what with wolves chasing the poor creature all the time? We, be it remembered, are hunters by nature—and we do *not* like being hunted. Some carefully conducted studies show that wolves kill only the young-and-incompetent and the diseased-incompetent among a herd of herbivores; the strong and healthy members are too hard and dangerous to catch. Probably the deer takes as great a satisfaction in outrunning the

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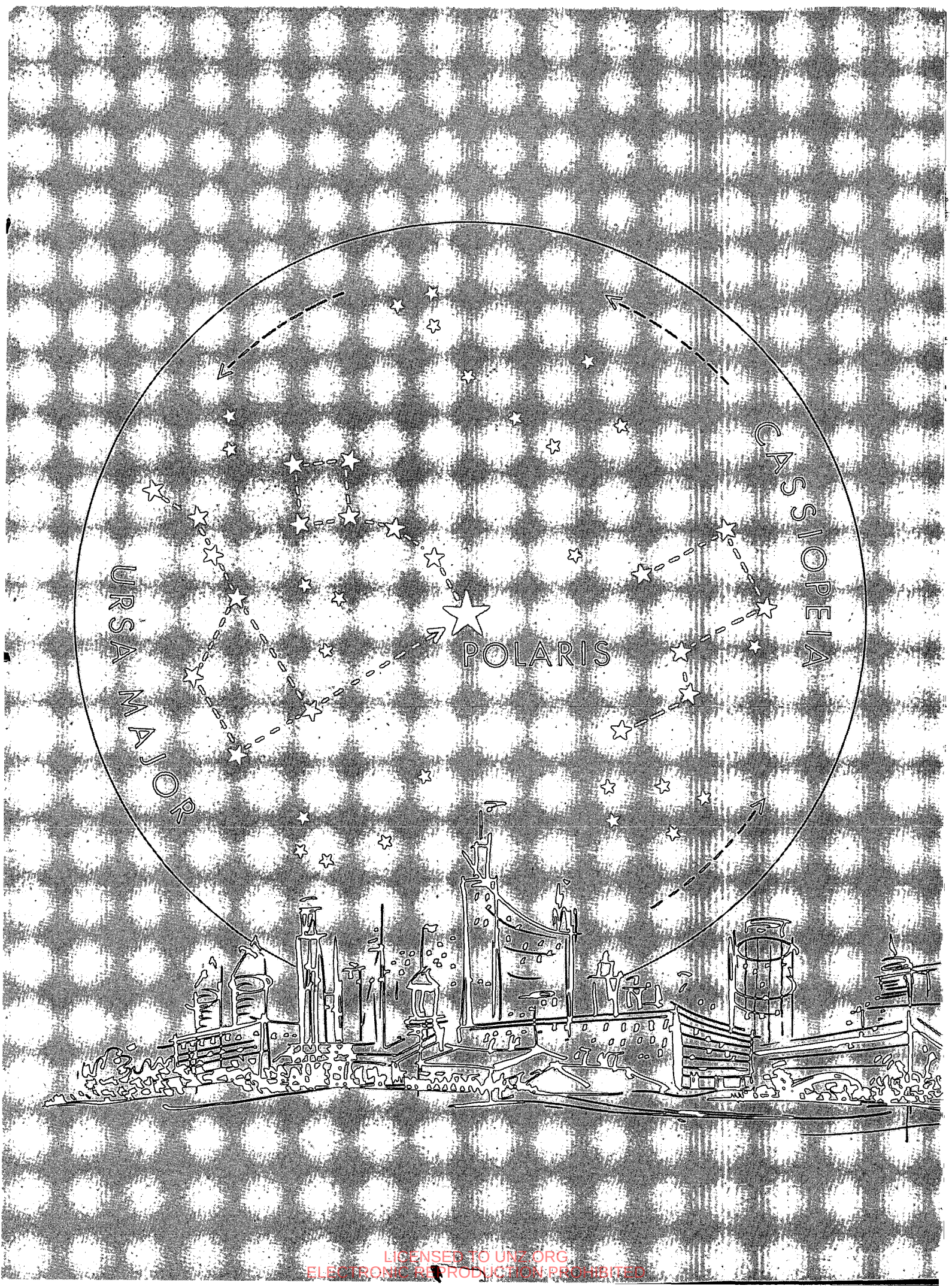

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WHICH POLARIS DO YOU MEAN?

As any resident of the southern hemisphere knows, Earth has no South Pole Star, while, as any resident of the Moon knows, the Moon has a real flaring spotlight of a South Pole Star—the third brightest in the Lunar skies—but no North Pole Star. Martians, on the other hand, have pretty inferior pole stars. . . .

BY ROBERT S. RICHARDSON

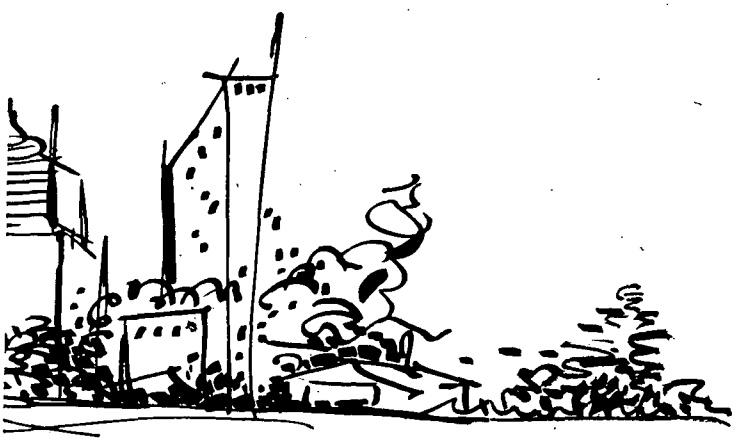

Fig. 1. *The north circumpolar constellations. Polaris can be located from the two stars in the end of the bowl of the Big Dipper, called "The Pointers."*

If you are an astronomer, and if you are outdoors with a bunch of people on a clear night, you know there is one question you are sure to be asked. "Where is the North Star? Which one is Polaris?"

If an astronomer doesn't know anything else, he is expected to know the constellations. An astronomer who can't point out Andromeda the Chained Maiden or Aquarius the Water Bearer is no good at all. The fact that the study of the constellations belongs to mythology and is only incidentally concerned with astronomy makes no difference. You are supposed to know them. I doubt if some of our most eminent astronomers can identify any constellations beyond a few like the Big Dipper that everybody knows. Although you might be surprised sometimes. S. Chandrasekhar is certainly one of the foremost theoretical astrophysicists in the world today. When I met him he talked to me mostly about science fiction. The evening when I had dinner with Werner von Braun and Chesley Bonestell we talked about everything but space travel.

Where I live in Los Angeles it is often difficult even for an astronomer to locate Polaris through the pall of smog that usually hangs over the city. If the Big Dipper is visible, you can generally do it. Draw a line through the two stars in the end of the bowl of the Big Dipper, as shown in Fig. 1. This line extended will lead you to a star of the second magnitude that is our North Star. Then after an impressive pause you can point to it and say, "There is Polaris!"

Of course, what we really mean is, "There is *our* Polaris." For in this space age people will soon have to specify *which Polaris they mean.* Are they speaking about the Polaris of the Earth? Or are they speaking about the Polaris of the Moon? Or Mars? For each one has a different North Star or Polaris. Also, why do we talk only about the *north* star? Why isn't the *south* star, the star that serves as Polaris in the southern hemisphere, just as important?

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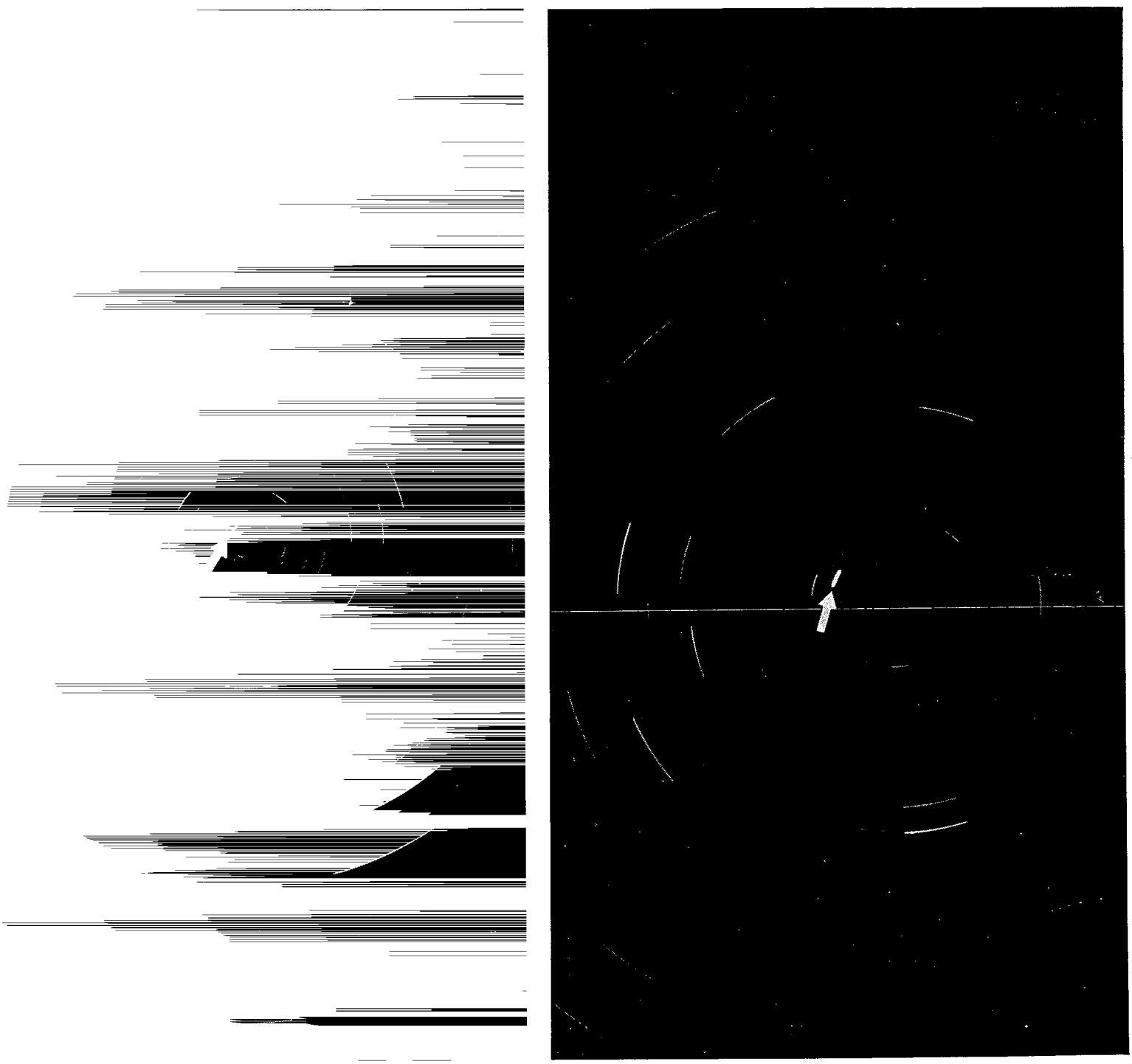

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WHICH POLARIS DO YOU MEAN?

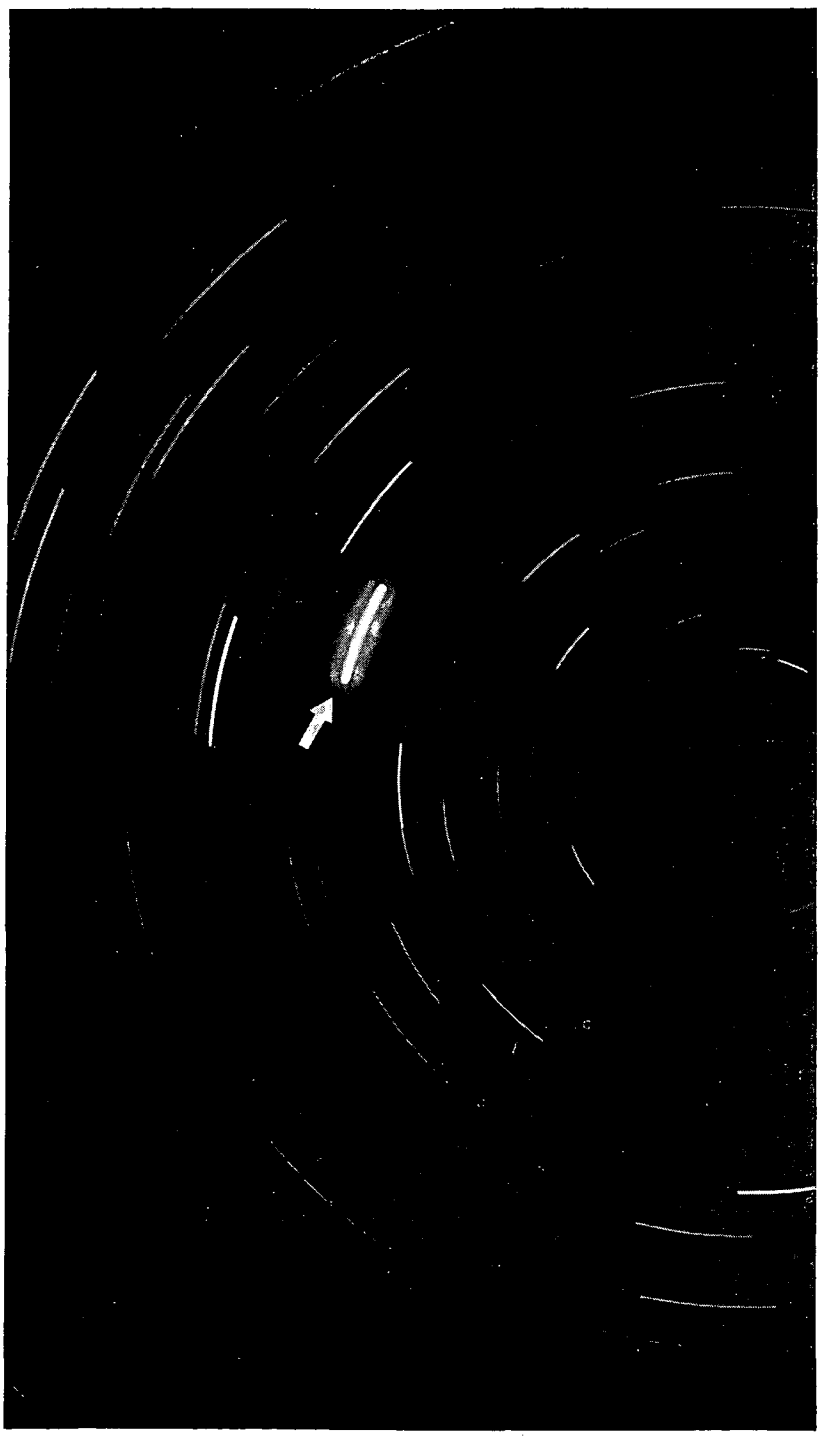

Fig. 2A. *Circumpolar star trails. These are each one-hour exposures, using a Nikon F camera on a standard tripod, mounted on a moving, spinning platform called Earth. The motion (19 miles per second) doesn't show, but the spin (360° per 24 hours) does. This shot was taken with a 28mm wide-angle lens, covering slightly more than an 80° field of view. In this one, Polaris does look like a pole star.*

Fig. 2B. *Another one-hour exposure, but this time with a 105mm slightly telescopic lens. In this one, it's clear that Polaris is not at the celestial pole.*

Fig. 2C. *And in this one-hour exposure, with the Nikkor 500mm reflex telescopic system, it's obvious that there are dozens of stars nearer the pole! The fainter ones visible in the original print don't show in the halftone reproduction—and none of those nearer the pole than Polaris were visible to the unaided eye when the pictures were taken! These were taken in the industrial-smog-clouded area of northern New Jersey. The Nikkor 500mm catadioptic unit uses a mirror four inches in diameter to focus light on a pinpoint area of the film; stars one hundred times fainter than the faintest visible record. Polaris isn't actually at the pole—but it's near, and it's conspicuously brilliant.*

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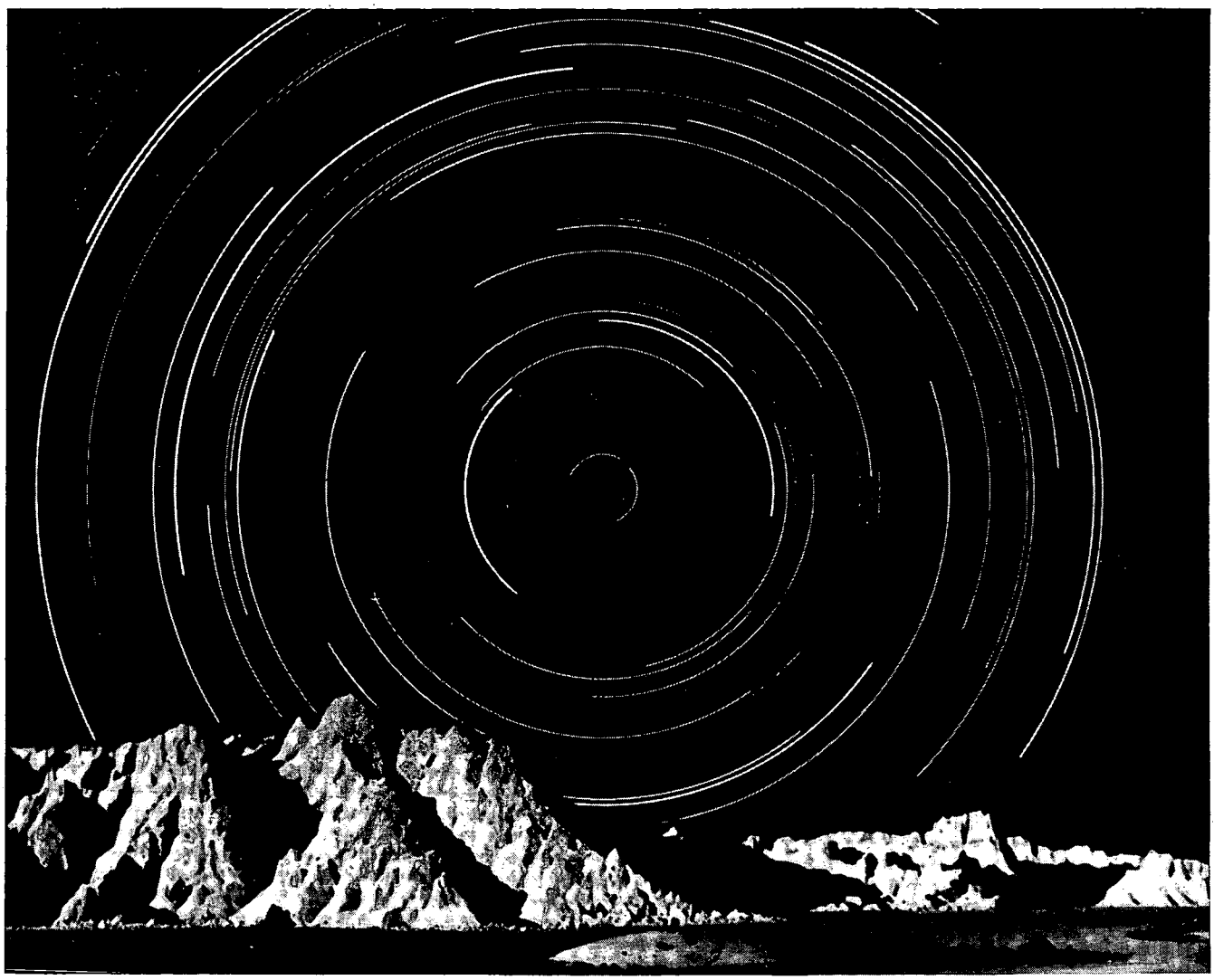

Photo courtesy Griffith Observatory, Los Angeles

Fig. 3. *The circumpolar star trails around the north celestial pole of the Moon. Since there is no bright star near this point the Moon does not have a North Star. These star trails show how a photograph of the north lunar sky would appear if actually taken on the surface of the Moon. The arc of the star trails tells us the length of the exposure immediately. These star trails are 103° in length, or about 0.29 of a revolution. The Earth rotates once in 23 hours 56 minutes. Hence, if this photo were taken from Earth, the exposure time would be about 7 hours. But the Moon rotates on its axis once in 27.3 days. The exposure time for this photograph of the lunar sky would correspond to about 8 days.*

Our Polaris, the North Star of the Earth, is just outside the limits of this picture. An actual photograph would almost certainly show fainter star trails than those depicted here, but I got tired putting them in after a while. The mountains in the foreground were taken from another lunar scene.

There are several technical errors in this scene. How many can you find?

Fig. 4. *Mars shows permanent surface markings from which its rotation period can be determined very accurately. This photograph of Mars was taken at the 60-inch telescope of the Mount Wilson Observatory by the author on August 10, 1956. The south polar cap is at the top. The Margaritifer Sinus is near the central meridian.*

It may seem incredible that we can determine the rotation period of a body that never comes closer than 34,800,000 miles with an accuracy of a thousandth of a second, but such is the case with Mars. An approximate value for the planet's rotation can be quickly obtained

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WHICH POLARIS DO YOU MEAN?

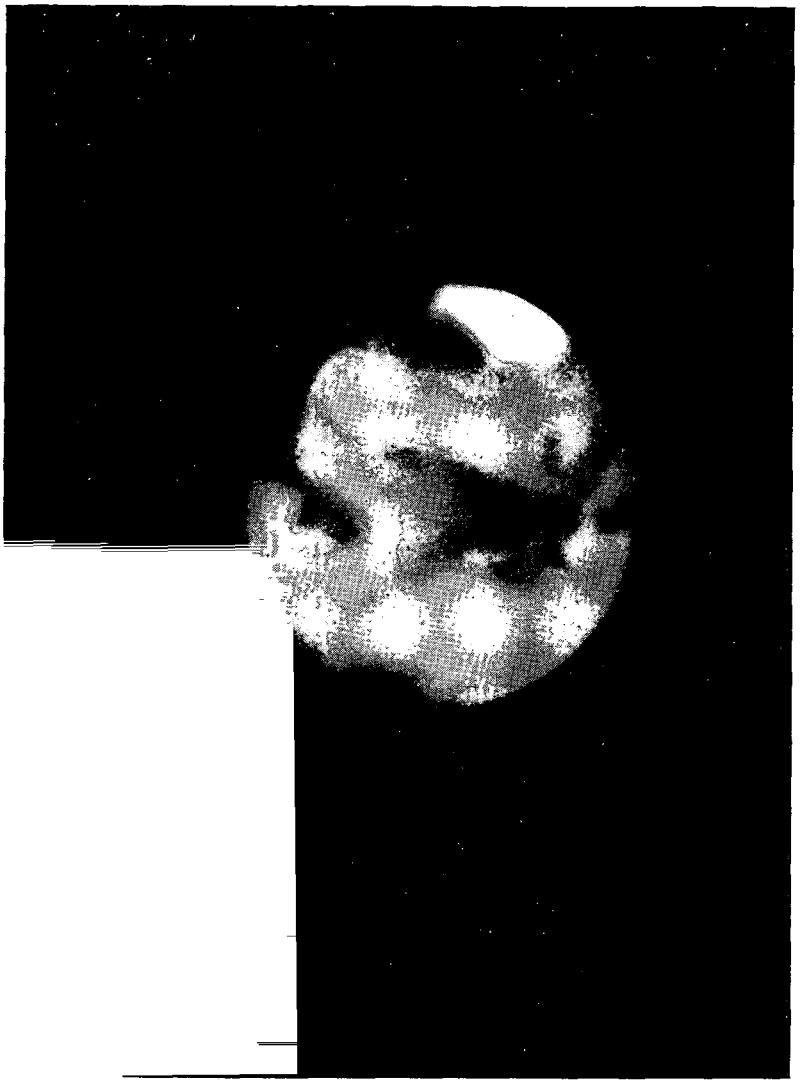

Photo courtesy Mount Wilson and Palomar Observatories

by timing the passage of well-defined markings across the central meridian. From this trial period the whole number of revolutions between observations separated by a very long interval can be found and an extremely accurate period determined. For example, an interval of more than 200 years is available if the drawings of Mars made by Hooke and Huygens are compared with observations today

The most recent determination of the rotation period of Mars was made in 1953 by Joseph Ashbrook, who preferred to use accurate positions of the markings from 1877 to 1952, rather than have recourse to the old drawings His result for the rotation period of Mars is 24 hours 37 minutes 22.6679 seconds! Ashbrook believes that the period of Mars can be determined so accurately that we should be able to detect variations in its rate, as has been done for Earth.

Before we can talk about the Polaris of other planets we should first get clearly in mind what we mean by the North Star or the South Star. How does a star qualify for this honor?

Draw a line through the axis of rotation of the Earth. But don't let it end at the north pole. Imagine it extended on out indefinitely into space until it pierces the celestial sphere. This imaginary point in the sky is called the north celestial pole. (There is a point in the southern sky exactly opposite it called the south celestial pole.) All during the night—and during the day as well—the stars of the northern hemisphere describe circles which are centered on the north celestial pole. If you take an exposure of several hours during the night on the north celestial pole, you will get a photograph like that in Fig. 2, which shows a portion of these star trails. The bright circumpolar trail near the center was made by our Polaris. Notice that it is not precisely at the position of the north celestial pole. Many people are under the impression that the North Star was placed at this point by Divine Providence for the purpose of marking this spot for us. Actually Polaris is about a degree away or twice the apparent width of the full moon.

If you have ever lived south of the equator, you know that the Earth has no South Star. There is no star brighter than the fourth magnitude within ten degrees of the south celestial pole. This point is in a vacant region of the sky roughly equidistant from the Large and Small Magellanic Clouds, and Alpha Crucis of the Southern Cross.

Now the axes of rotation of the different planets point in a variety of directions, so that each planet has a different North and South Star. How do you find out how the axis of rotation of a planet is oriented? It is fairly easy if the planet shows well-defined markings on its surface. Thus the position in the sky of the north pole of the Moon and Mars have been determined very accurately. (Figs. 3 and 4). This can also be done for

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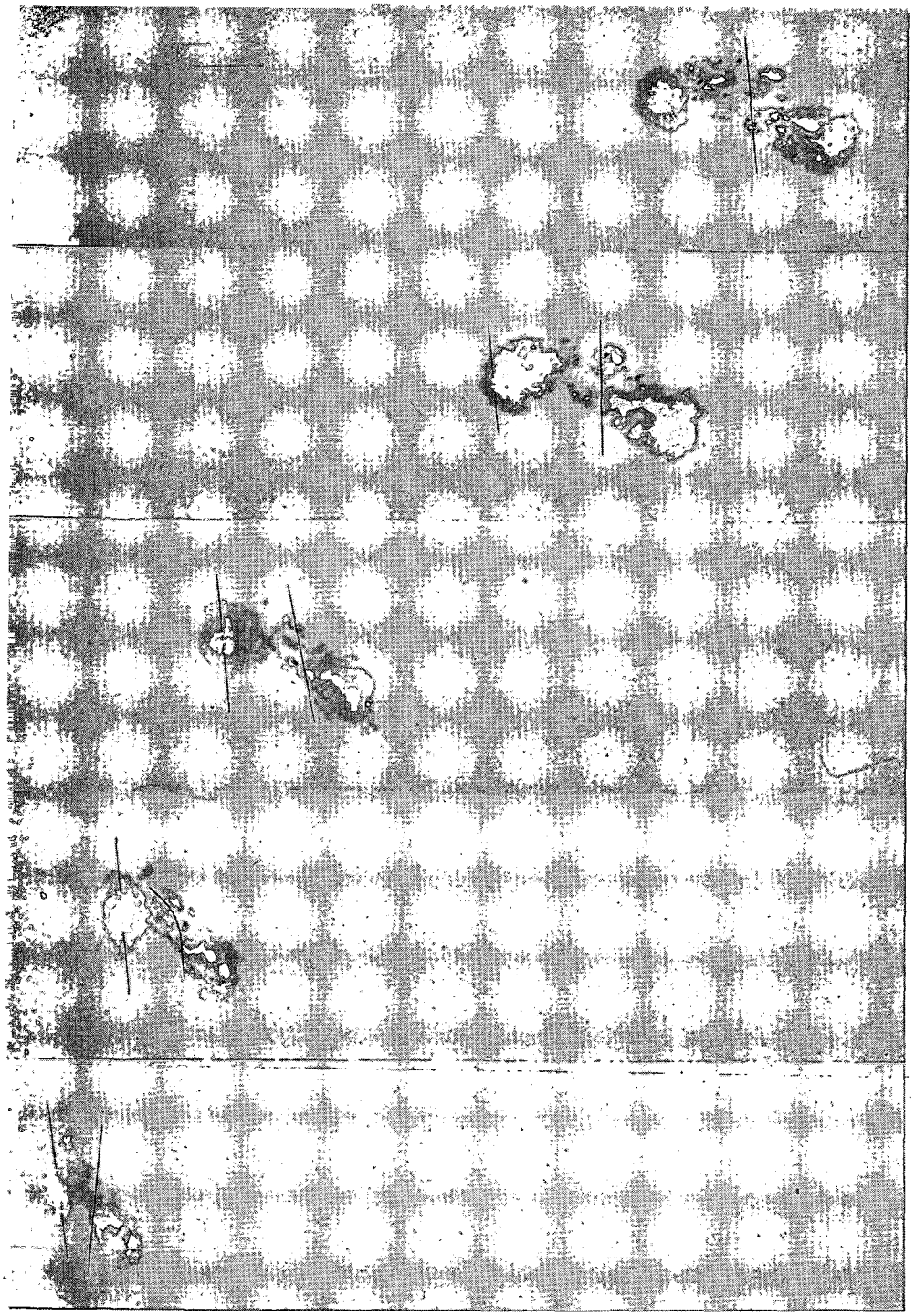

Fig. 5. *A period for the rotation of the Sun can be obtained by tracking long-lived spot groups as they are carried across the solar disk. The orientation of the axis of the Sun can also be found from sunspot positions. We say "a period" for the rotation of the Sun because its rate of rotation is different for different latitudes. The Sun rotates fastest at the equator and more slowly toward the poles. Since long-lived spots are seldom seen farther from the equator than about 35, this method tells us nothing about the rate of solar rotation in high latitudes.*

The solar rotation in any latitude may be found by the Doppler shift of the spectrum lines at the Sun's limb. Considering the high precision with which the positions of the spectrum lines can be measured, the results obtained by different observers at different times differ by surprising amounts. The spectroscopic measures indicate the rotation of the sun is variable. On the other hand the solar rotation in the same latitude found from long-lives spots has remained essentially constant through the years. The table shows the difference between the two methods. The period for the spots is taken from values obtained by using single, stable spots only, observed at Mount Wilson during four sunspot cycles extending over about 44 years. The spectroscopic values are from those found by W. S. Adams at Mount Wilson in 1908. (See Table II below.)

The apparent *solar rotation found from watching a spot is about 27 days. When this is corrected for the revolution of the Earth around the Sun the period comes out about 25 days. The spectroscopic results also have to be corrected for the Earth's motion. (The first astronomer who measured the solar rotation in 1889 forgot to do this).*

TABLE II

SOLAR ROTATION PERIOD

Latitude	*Spots*	*Spectrum*
0°	*25.14 days*	*24.64 days*
15	25.50	25.41
30	*26.53*	*26.45*
45		*28.54*
60		*30.99*
75		*33.07*

The spectroscopic measures of solar rotation show a peculiar effect which, so far as I am aware, has never been explained to everybody's satisfaction. The shift of lines toward the red at the receding limb of the Sun is persistently larger than the shift of the lines toward the violet at the approaching limb. The general theory of relativity predicts a shift of the lines toward the red arising from the loss of energy which the light quanta undergo in escaping from the gravitational attraction of the Sun. But this relativity shift should be the same for all points on the disk of the Sun. The shift of the lines is also probably complicated by rising and descending currents in the solar atmosphere. The solar "limb effect" has been a puzzle to astrophysicists for more than half a century.

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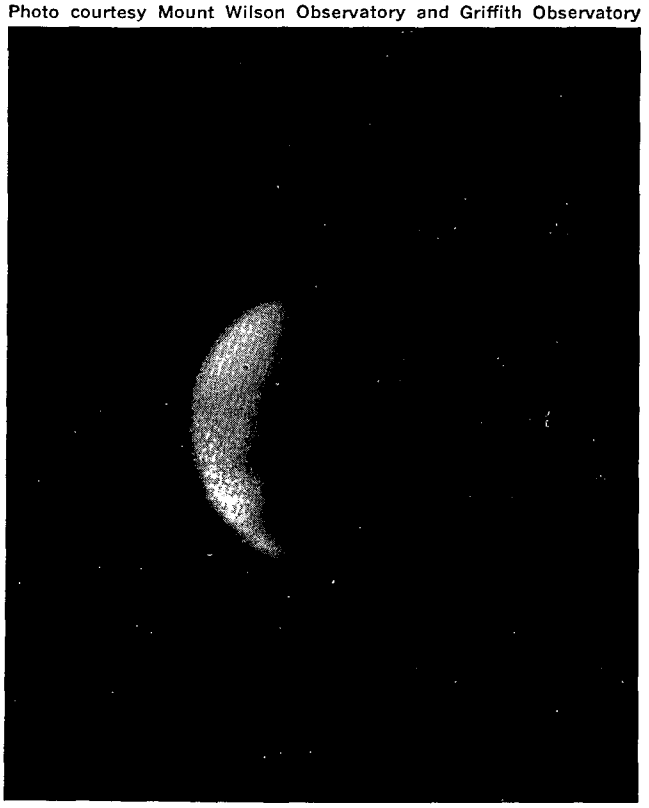
Fig. 6. *A photograph of Venus in ultraviolet light obtained by F. E. Ross in 1927 with the 60-inch telescope of the Mount Wilson Observatory. When Venus is observed visually or when photographed in visible or infrared light the planet usually shows only a blank disk. But when photographed in ultraviolet light the disk almost always shows bands as in this image. Attempts have been made to determine the orientation of the axis of Venus on the assumption that the ultraviolet bands are parallel to the planet's equator.*

Ross's photographs of Venus are among the best ever obtained of that planet. This photograph of Venus has never been published before in the form shown here.

Photo courtesy Mount Wilson Observatory and Griffith Observatory



bodies that show semipermanent markings, such as the Sun (Fig. 5) and Jupiter. The north celestial pole of Saturn has been found from the orientation of the rings which lie in the plane of the planet's equator. The orientation of the axes of Uranus and Neptune, which show no surface markings, has been found from observations of their satellites.

G. P. Kuiper and myself have tried to determine the orientation of the axis of Venus on the assumption that the bands which show on the disk in ultraviolet light are parallel to the equator. (Fig. 6) Our results give positions for the axis which differ in direction by twenty-nine degrees, which is probably about as good agreement as can be expected. The method is of doubtful validity in my opinion, but then it is the only method we have.

Observations of the markings on Mercury by a few men such as Antoniadi and Schiaparelli who have paid any attention to this planet, indicate that the axis is probably nearly perpendicular to the plane of the planet's orbit. (Fig. 7). All we have to go on for Pluto are the photometric observations of Merle F. Walker and Robert Hardie made in 1954-55 with the 60-inch and 100-inch telescopes on Mount Wilson. From variations in the light curve of Pluto they derived a rotation period of 6.390 days. They believe that the range of 0.1 magnitudes in the integrated light of Pluto indicates that they were observing the planet nearly equator-on, rather than pole-on, at this time. It is interesting to note that we probably know the rotation period of Pluto, the farthest planet, better than we do that of Venus, the planet that comes nearest us. In fact, we still can't say anything about the rotation of Venus except that it must be slow, longer than ten days perhaps.

The case of Uranus deserves special attention. The axis of Uranus is oriented in such a way that it is hard to decide which *is* its north pole and south pole. It reminds me of the ani-

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WHICH POLARIS DO YOU MEAN?

mal I had to draw when I was taking biology in high school. I couldn't tell which was its front end and which was its back end. This raises the question: How do we decide which is the north pole of a planet anyhow? Suppose you were confronted by a planet revolving around Sirius which you had never seen before. In making out your report how would you know which pole to call the north pole?

Astronomers have agreed that if we look down on the pole of a planet, and see the markings on its surface moving around the pole in a direction opposite to the hands of a watch—counterclockwise—then this is the north pole of the planet. Of course, if we are looking down on the south pole the motion will appear clockwise. In the solar system counterclockwise motion is said to be *direct*. I tried to explain this to my wife one time with no success whatever.

If you look "down" on the solar system from the direction of the constellation of Draco, all the planets would appear to be revolving around the sun counterclockwise. The orbit of the Earth is taken as the basic plane of reference in the surface system. If you passed a plane through the orbit of the Earth and extended it out indefinitely, it would cut the celestial sphere in a great circle called the ecliptic. The north pole of the ecliptic lies very nearly in the direction of the fifth magnitude star 36 Draconis. Or specifically, for those of you who know your way around the sky, at RA 18 hours, DEC 66½ N.

If we were gifted with some kind of super-sensitive vision, so that we could see the planets rotating on their axes, we would seldom be in doubt as to which pole was which. We would find that Jupiter, for example, revolves with its axis nearly vertical or straight-up-and-down relative to its orbit. To fix the idea, you can think of Jupiter as being a sentry marching stiff and erect around a building. The same general statement applies to the Earth and Mars and Saturn, although their axes are tilted at angles of about twenty-five degrees from the vertical. Their direction of rotation is also direct; that is, in the same direction as their revolution around the Sun. They are like sentries marching around a building who have gotten tired, so that they have developed a bad sag to one side instead of standing upright. But still there is no doubt as to which is their north pole and south pole, or which is their head and feet. Neither is there any serious doubt as to which is the north pole of the other planets —except Uranus. For Uranus revolves around the Sun with its axis of rotation almost in the plane of its orbit. In our analogy, which is now getting rather strained, it is like a sentry crawling around the building on his stomach, or even with his head a little lower than the rest of his body. How shall we decide which is the north pole and which is the south pole for such a planet?

An investigation of the motion of Ariel, Umbriel, Titania, and Oberon, shows that they are revolving in the plane of the equator of Uranus. The plane of the equator has been determined from spectographic observations, supported by Lowell's observations of faint bands across the disk. These spectrographic observations show that the satellites are revolving in the same direction the planet is rotating. Now, if we look at that pole of Uranus around which the satellites are revolving counterclockwise, then by definition that must be the north pole. It turns out that the north pole of Uranus is directed eight degrees to the south side of the ecliptic. Nevertheless, this should properly be regarded as the north pole of Uranus, as shown in Fig. 9.

The data are collected in Table I. Columns 2 and 3 give the RA and DEC of the north celestial pole of the planets so far as they are known. Columns 4 and 5 give the Polaris that I have selected. The position of the south celestial pole is found by adding 12 hours to the RA of the north celestial pole, and changing the sign of the DEC. For example, the position of the south pole of Jupiter is 5 hours 52 minutes, 64°33′ S.

continued on page 84

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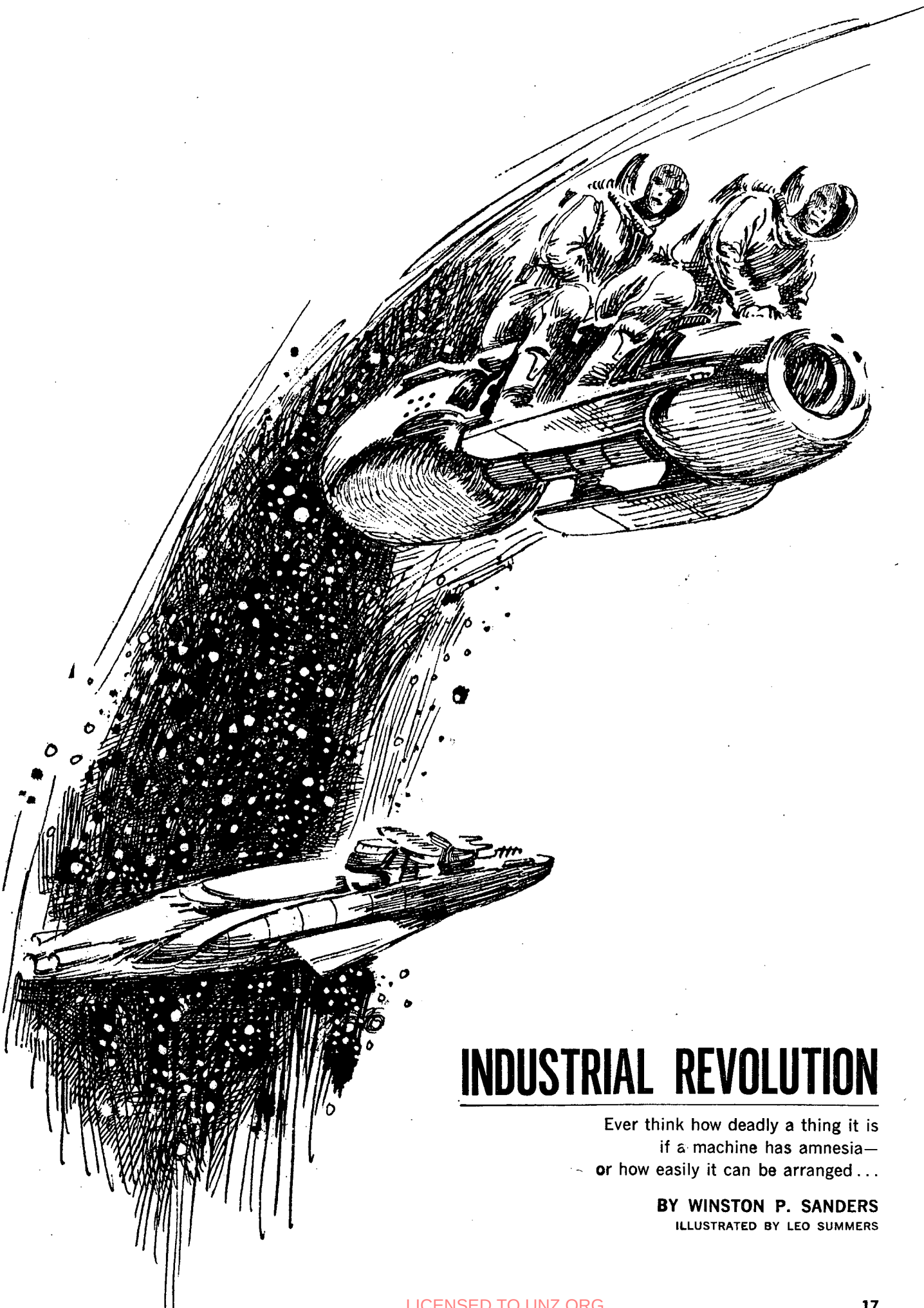

INDUSTRIAL REVOLUTION

Ever think how deadly a thing it is
if a machine has amnesia—
or how easily it can be arranged . . .

BY WINSTON P. SANDERS
ILLUSTRATED BY LEO SUMMERS

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"Well, yes," Amspaugh admitted, "it was a unique war in many ways, including its origin. However, there are so many analogies to other colonial revolutions—" His words trailed off as usual.

"I know. Earth's mercantile policies and so forth," said Lindgren. He fancies himself a student of interplanetary history. This has led to quite a few arguments since Amspaugh, who teaches in that field, joined the Club. Mostly they're good. I went to the bar and got myself another drink, listening as the mine owner's big voice went on:

"But what began it? When did the asterites first start realizing they weren't pseudopods of a dozen Terrestrial nations, but a single nation in their own right? There's the root of the revolution. And it can be pinned down, too."

"'Ware metaphor!" cried someone at my elbow. I turned and saw Missy Blades. She'd come quietly into the lounge and started mixing a gin and bitters.

The view window framed her white head in Orion as she moved toward the little cluster of seated men. She took a fat cigar from her pocket, struck it on her shoe sole, and added her special contribution to the blue cloud in the room after she sat down.

"Excuse me," she said. "I couldn't help that. Please go on." Which I hope relieves you of any fear that she's an Unforgettable Character. Oh, yes, she's old as Satan now; her toil and guts and conniving make up half the biography of the Sword; she manned a gun turret at Ceres, and was mate of the *Tyrfing* on some of the earliest Saturn runs when men took their lives between their teeth because they needed both hands free; her sons and grandsons fill the Belt with their brawling ventures; she can drink any ordinary man to the deck; she's one of the three women ever admitted to the Club. But she's also one of the few genuine ladies I've known in my life.

"Uh, well." Lindgren grinned at her. "I was saying, Missy, the germ of the revolution was when the Stations armed themselves. You see, that meant more than police powers. It implied a degree of sovereignty. Over the years, the implication grew."

"Correct." Orloff nodded his bald head. "I remember how the Governing Commission squalled when the Station managers first demanded the right. They foresaw trouble. But if the Stations belonging to one country put in space weapons, what else could the others do?"

"They should have stuck together and all been firm about refusing to allow it," Amspaugh said. "From the standpoint of their own best interests, I mean."

"They tried to," Orloff replied. "I hate to think how many communications we sent home from our own office, and the others must have done the same. But Earth was a long way off. The Station bosses were close. Inverse square law of political pressure."

"I grant you, arming each new little settlement proved important," Amspaugh said. "But really, it expressed nothing more than the first inchoate stirrings of asteroid nationalism. And the origins of that are much more subtle and complex. For instance . . . er . . ."

"You've got to have a key event somewhere," Lindgren insisted. "I say that this was it."

A silence fell, as will happen in conversation. I came back from the bar and settled myself beside Missy. She looked for a while into her drink, and then out to the stars. The slow spin of our rock had now brought the Dippers into view. Her faded eyes sought the Pole Star—but it's Earth's, not our own any more—and I wondered what memories they were sharing. She shook herself the least bit and said:

"I don't know about the sociological ins and outs. All I know is, a lot of things happened, and there wasn't any pattern to them at the time. We just slogged through as best we were able, which wasn't really very good. But I can identify one of those wriggling roots for you, Sigurd. I was there when the question of arming the Stations first came up. Or, rather, when the incident occurred that led directly to the question being raised."

Our whole attention went to her. She didn't dwell on the past as often as we would have liked.

A slow, private smile crossed her lips. She looked beyond us again. "As a matter of fact," she murmured, "I got my husband out of it." Then quickly, as if to keep from remembering too much:

"Do you care to hear the story? It was when the Sword was just getting started. They'd established themselves on SSC 45—oh, never mind the catalogue number. Sword Enterprises, because Mike Blades' name suggested it—what kind of name could you get out of Jimmy Chung, even if he was the senior partner? It'd sound too much like a collision with a meteorite—so naturally the asteroid also came to be called the Sword. They began on the borrowed shoestring that was usual in those days. Of course, in the Belt a shoestring has to be mighty long, and finances got stretched to the limit. The older men here will know how much had to be done by hand, in mortal danger, because machines were too expensive. But in spite of everything, they succeeded. The Station was functional and they were ready to start business when—"

It was no coincidence that the Jupiter craft were arriving steadily when the battleship came. Construction had been scheduled with this in mind, that the Sword should be approaching conjunction with the king planet, making direct shuttle service feasible, just as the chemical plant went into service. We need not consider how much struggle and heartbreak had gone into meeting that schedule. As for the battleship, she appeared because the fact that a Station in just this orbit was about to commence operations was news important enough to cross the Solar System and push through many strata of bureaucracy. The heads of the recently elected North American government became suddenly, fully aware of what had been going on.

Michael Blades was outside, overseeing the installation of a receptor, when his earplug buzzed. He thrust his

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chin against the tuning plate, switching from gang to interoffice band. "Mike?" said Avis Page's voice. "You're wanted up front."

"Now?" he objected. "Whatever for?"

"Courtesy visit from the NASS *Altair*. You've lost track of time, my boy."

"What the . . . the jumping blue blazes are you talking about? We've had our courtesy visit. Jimmy and I both went over to pay our respects, and we had Rear Admiral Hulse here to dinner. What more do they expect, for Harry's sake?"

"Don't you remember? Since there wasn't room to entertain his officers, you promised to take them on a personal guided tour later. I made the appointment the very next watch. Now's the hour."

"Oh, yes, it comes back to me. Yeah. Hulse brought a magnum of champagne with him, and after so long a time drinking recycled water, my capacity was shot to pieces. I got a warm glow of good fellowship on, and offered—Let Jimmy handle it. I'm busy."

"The party's too large, he says. You'll have to take half of them. Their gig will dock in thirty minutes."

"Well, depute somebody else."

"That'd be rude, Mike. Have you forgotten how sensitive they are about rank at home?" Avis hesitated. "If what I believe about the mood back there is true, we can use the good will of high-level Navy personnel. And any other influential people in sight."

Blades drew a deep breath. "You're too blinking sensible. Remind me to fire you after I've made my first ten million bucks."

"What'll you do for your next ten million, then?" snipped his secretary-file clerk-confidante-advisor-et cetera.

"Nothing. I'll just squander the first."

"Goody! Can I help?"

"Uh . . . I'll be right along." Blades switched off. His ears felt hot, as often of late when he tangled with Avis, and he unlimbered only a few choice oaths.

"Troubles?" asked Carlos Odonaju.

Blades stood a moment, looking around, before he answered. He was on the wide end of the Sword, which was shaped roughly like a truncated pyramid. Beyond him and his half dozen men stretched a vista of pitted rock, jutting crags, gulf-black shadows, under the glare of floodlamps. A few kilometers away, the farthest horizon ended, chopped off like a cliff. Beyond lay the stars, crowding that night which never ends. It grew very still while the gang waited for his word. He could listen to his own lungs and pulse, loud in the spacesuit; he could even notice its interior smell, blend of plastic and oxygen cycle chemicals, flesh and sweat. He was used to the sensation of hanging upside down on the surface, grip-soled boots holding him against that fractional gee by which the asteroid's rotation overcame its feeble gravity. But it came to him that this was an eerie bat-fashion way for an Oregon farm boy to stand.

Oregon was long behind him, though, not only the food factory where he grew up but the coasts where he had fished and the woods where he had tramped. No loss. There'd always been too many tourists. You couldn't escape from people on Earth. Cold and vacuum and raw rock and everything, the Belt was better. It annoyed him to be interrupted here.

Could Carlos take over as foreman? N-no, Blades decided, not yet. A gas receptor was an intricate piece of equipment. Carlos was a good man of his hands. Every one of the hundred-odd in the Station necessarily was. But he hadn't done this kind of work often enough.

"I have to quit," Blades said. "Secure the stuff and report to Buck Meyers over at the dock, the lot of you. His crew's putting in another recoil pier, as I suppose you know. They'll find jobs for you. I'll see you here again on your next watch."

He waved—being half the nominal ownership of this place didn't justify snobbery, when everyone must work together or die—and stepped off toward the nearest entry lock with that flowing spaceman's pace which always keeps one foot on the ground. Even so, he didn't unshackle his inward-reeling lifeline till he was inside the chamber.

On the way he topped a gaunt ridge and had a clear view of the balloons that were attached to the completed receptors. Those that were still full bulked enormous, like ghostly moons. The Jovian gases that strained their tough elastomer did not much blur the stars seen through them; but they swelled high enough to catch the light of the hidden sun and shimmer with it. The nearly discharged balloons hung thin, straining outward. Two full ones passed in slow orbit against the constellations. They were waiting to be hauled in and coupled fast, to release their loads into the Station's hungry chemical plant. But there were not yet enough facilities to handle them at once—and the *Pallas Castle* would soon be arriving with another—Blades found that he needed a few extra curses.

Having cycled through the air lock, he removed his suit and stowed it, also the heavy gloves which kept him from frostbite as he touched its space-cold exterior. Tastefull y-clad in a Navy surplus Long John, he started down the corridors.

Now that the first stage of burrowing within the asteroid had been completed, most passages went through its body, rather than being plastic tubes snaking across the surface. Nothing had been done thus far about facing them. They were merely shafts, two meters square, lined with doorways, ventilator grilles, and fluoropanels. They had no thermocoils. Once the nickel-iron mass had been sufficiently warmed up, the waste heat of man and his industry kept it that way. The dark, chipped-out tunnels throbbed with machine noises. Here and there a girlie picture or a sentimental landscape from Earth was posted. Men moved busily along them, bearing tools, instruments, supplies. They were from numerous countries, those men,

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though mostly North Americans, but they had acquired a likeness, a rangy leathery look and a free-swinging stride, that went beyond their colorful coveralls.

"Hi, Mike . . . How's she spinning? . . . Hey, Mike, you heard the latest story about the Martian and the bishop? . . . Can you spare me a minute? We got troubles in the separator manifolds . . . What's the hurry, Mike, your batteries overcharged?" Blades waved the hails aside. There was need for haste. You could move fast indoors, under the low weight which became lower as you approached the axis of rotation, with no fear of tumbling off. But it was several kilometers from the gas receptor end to the people end of the asteroid.

He rattled down a ladder and entered his cramped office out of breath. Avis Page looked up from her desk and wrinkled her freckled snub nose at him. "You ought to take a shower, but there isn't time," she said. "Here, use my antistinker." She threw him a spray cartridge with a deft motion. "I got your suit and beardex out of your cabin."

"Have I no privacy?" he grumbled, but grinned in her direction. She wasn't much to look at—not ugly, just small, brunette, and unspectacular—but she was a supernova of an assistant. Make somebody a good wife some day. He wondered why she hadn't taken advantage of the situation here to snaffle a husband. A dozen women, all but two of them married, and a hundred men, was a ratio even more lopsided than the norm in the Belt. Of course, with so much work to do, and with everybody conscious of the need to maintain cordial relations, sex didn't get much chance to rear its lovely head. Still—

She smiled back with the gentleness that he found disturbing when he noticed it. "Shoo," she said. "Your guests will be here any minute. You're to meet them in Jimmy's office."

Blades ducked into the tiny washroom. He wasn't any 3V star himself, he decided as he smeared cream over his face: big, homely, red-haired. *But not something you'd be scared to meet in a dark alley, either,* he added smugly. In fact, there had been an alley in Aresopolis . . . Things were expected to be going so smoothly by the time they approached conjunction with Mars that he could run over to that sinful ginful city for a vacation. Long overdue . . . whooee! He wiped off his whiskers, shucked the zipskin, and climbed into the white pants and high-collared blue tunic that must serve as formal garb.

Emerging, he stopped again at Avis' desk. "Any message from the *Pallas?*" he asked.

"No," the girl said. "But she ought to be here in another two watches, right on sked. You worry too much, Mike."

"Somebody has to, and I haven't got Jimmy's Buddhist ride-with-the-punches attitude."

"You should cultivate it." She grew curious. The brown eyes lingered on him. "Worry's contagious. You make me fret about you."

"Nothing's going to give me an ulcer but the shortage of booze on this rock. Uh, if Bill Mbolo should call about those catalysts while I'm gone, tell him—" He ran off a string of instructions and headed for the door.

Chung's hangout was halfway around the asteroid, so that one chief or the other could be a little nearer the scene of any emergency. Not that they spent much time at their desks. Shorthanded and undermechanized, they were forever having to help out in the actual construction. Once in a while Blades found himself harking wistfully back to his days as an engineer with Solar Metals: good pay, interesting if hazardous work on flying mountains where men had never trod before, and no further responsibilities. But most asterites had the dream of becoming their own bosses.

When he arrived, the *Altair* officers were already there, a score of correct young men in white dress uniforms. Short, squat, and placid looking, Jimmy Chung stood making polite conversation. "Ah, there," he said, "Lieutenant Ziska and gentlemen, my partner, Michael Blades, Mike, may I present—"

Blades' attention stopped at Lieutenant Ziska. He heard vaguely that she was the head quartermaster officer. But mainly she was tall and blond and blue-eyed, with a bewitching dimple when she smiled, and filled her gown the way a Cellini Venus doubtless filled its casting mold.

"Very pleased to meet you, Mr. Blades," she said as if she meant it. Maybe she did! He gulped for air.

"And Commander Liebknecht," Chung said across several light-years. "Commander Liebknecht. *Commander Liebknecht.*"

"Oh. Sure. 'Scuse." Blades dropped Lieutenant Ziska's hand in reluctant haste. "Hardjado, C'mander Liebfraumilch."

Somehow the introductions were gotten through. "I'm sorry we have to be so inhospitable," Chung said, "but you'll see how crowded we are. About all we can do is show you around, if you're interested."

"Of course you're interested," said Blades to Lieutenant Ziska. "I'll show you some gimmicks I thought up myself."

Chung scowled at him. "We'd best divide the party and proceed along alternate routes," he said. "We'll meet again in the mess for coffee. Lieutenant Ziska, would you like to—"

"Come with me? Certainly," Blades said.

Chung's glance became downright murderous. "I thought—" he began.

"Sure." Blades nodded vigorously. "You being the senior partner, you'll take the highest ranking of these gentlemen, and I'll be in Scotland before you. C'mon, let's get started. May I?" He offered the quartermistress his arm. She smiled and took it. He supposed that eight or ten of her fellows trailed them.

The first disturbing note was sounded on the verandah.

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They had glanced at the cavelike dormitories where most of the personnel lived; at the recreation dome topside which made the life tolerable; at kitchen, sick bay, and the other service facilities; at the hydroponic tanks and yeast vats which supplied much of the Station's food; at the tiny cabins scooped out for the top engineers and the married couples. Before leaving this end of the asteroid, Blades took his group to the verandah. It was a clear dome jutting from the surface, softly lighted, furnished as a primitive officers' lounge, open to a view of half the sky.

"Oh-h," murmured Ellen Ziska. Unconsciously she moved closer to Blades.

Young Lieutenant Commander Gilbertson gave her a somewhat jaundiced look. "You've seen deep space often enough before," he said.

"Through a port or a helmet." Her eyes glimmered enormous in the dusk. "Never like this."

The stars crowded close in their wintry myriads. The galactic belt glistened, diamond against infinite darkness. Vision toppled endlessly outward, toward the far mysterious shimmer of the Andromeda Nebula; silence was not a mere absence of noise, but a majestic presence, the seething of suns.

"What about the observation terrace at Leyburg?" Gilbertson challenged.

"That was different," Ellen Ziska said. "Everything was safe and civilized. This is like being on the edge of creation."

Blades could see why Goddard House had so long resisted the inclusion of female officers on ships of the line, despite political pressure at home and the Russian example abroad. He was glad they'd finally given in. Now if only he could build himself up as a dashing, romantic type . . . But how long would the *Altair* stay? Her stopover seemed quite extended already, for a casual visit in the course of a routine patrol cruise. He'd have to work fast.

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"Yes, we are pretty isolated," he said. "The Jupiter ships just unload their balloons, pick up the empties, and head right back for another cargo."

"I don't understand how you can found an industry here, when your raw materials only arrive at conjunction," Ellen said.

"Things will be different once we're in full operation," Blades assured her. "Then we'll be doing enough business to pay for a steady input, transshipped from whatever depot is nearest Jupiter at any given time."

"You've actually built this simply to process . . . gas?" Gilbertson interposed. Blades didn't know whether he was being sarcastic or asking a genuine question. It was astonishing how ignorant Earthsiders, even space-traveling Earthsiders, often were about such matters.

"Jovian gas is rich stuff," he explained. "Chiefly hydrogen and helium, of course; but the scoopships separate out most of that during a pickup. The rest is ammonia, water, methane, a dozen important organics, including some of the damn . . . doggonedest metallic complexes you ever heard of. We need them as the basis of a chemosynthetic industry, which we need for survival, which we need if we're to get the minerals that were the reason for colonizing the Belt in the first place." He waved his hand at the sky. "When we really get going, we'll attract settlement. This asteroid has companions, waiting for people to come and mine them. Homeships and orbital stations will be built. In ten years there'll be quite a little city clustered around the Sword."

"It's happened before," nodded tight-faced Commander Warburton of Gunnery Control.

"It's going to happen a lot oftener," Blades said enthusiastically. "The Belt's going to grow!" He aimed his words at Ellen. "This is the real frontier. The planets will never amount to much. It's actually harder to maintain human-type conditions on so big a mass, with a useless atmosphere around you, than on a lump in space like this. And the gravity wells are so deep. Even given nuclear power, the energy cost of really exploiting a planet is prohibitive. Besides which, the choice minerals are buried under kilometers of rock. On a metallic asteroid, you can find almost everything you want directly under your feet. No limit to what you can do."

"But your own energy expenditure—" Gilbertson objected.

"That's no problem." As if on cue, the worldlet's spin brought the sun into sight. Tiny but intolerably brilliant, it flooded the dome with harsh radiance. Blades lowered the blinds on that side. He pointed in the opposite direction, toward several sparks of equal brightness that had manifested themselves.

"Hundred-meter parabolic mirrors," he said. "Easy to make; you spray a thin metallic coat on a plastic backing. They're in orbit around us, each with a small geegee unit to control drift and keep it aimed directly at the sun. The focused radiation charges heavy-duty accumulators, which we then collect and use for our power source in all our mobile work."

"Do you mean you haven't any nuclear generator?" asked Warburton.

He seemed curiously intent about it. Blades wondered why, but nodded. "That's correct. We don't want one. Too dangerous for us. Nor is it necessary. Even at this distance from the sun, and allowing for assorted inefficiencies, a mirror supplies better than five hundred kilowatts, twenty-four hours a day, year after year, absolutely free."

"Hm-m-m. Yes." Warburton's lean head turned slowly about, to rake Blades with a look of calculation. "I understand that's the normal power system in Stations of this type. But we didn't know if it was used in your case, too."

Why should you care? Blades thought.

He shoved aside his faint unease and urged Ellen toward the dome railing. "Maybe we can spot your ship, Lieutenant, uh, Miss Ziska. Here's a telescope. Let me see, her orbit ought to run about so . . ."

He hunted until the *Altair* swam into the viewfield. At this distance the spheroid looked like a tiny crescent moon, dully painted; but he could make out the sinister shapes of a rifle turret and a couple of missile launchers. "Have a look," he invited. Her hair tickled his nose, brushing past him. It had a delightful sunny odor.

"How small she seems," the girl said, with the same note of wonder as before. "And how huge when you're aboard."

Big, all right, Blades knew, and loaded to the hatches with nuclear hellfire. But not massive. A civilian spaceship carried meteor plating, but since that was about as useful as wet cardboard against modern weapons, warcraft sacrificed it for the sake of mobility. The self-sealing hull was thin magnesium, the outer shell periodically renewed as cosmic sand eroded it.

"I'm not surprised we orbited, instead of docking," Ellen remarked. "We'd have butted against your radar and bellied into your control tower."

"Well, actually, no," said Blades. "Even half finished, our dock's big enough to accommodate you, as you'll see today. Don't forget, we anticipate a lot of traffic in the future. I'm puzzled why you didn't accept our invitation to use it."

"Doctrine!" Warburton clipped.

The sun came past the blind and touched the officers' faces with incandescence. Did some look startled, one or two open their mouths as if to protest and then snap them shut again at a warning look? Blades' spine tingled. *I never heard of any such doctrine,* he thought, *least of all when a North American ship drops in on a North American Station.*

"Is . . . er . . . is there some international crisis brewing?" he inquired.

"Why, no." Ellen straightened from the telescope. "I'd say relations have seldom been as good as they are now. What makes you ask?"

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"Well, the reason your captain didn't—"

"Never mind," Warburton said. "We'd better continue the tour, if you please."

Blades filed his misgivings for later reference. He might have fretted immediately, but Ellen Ziska's presence forbade that. A sort of Pauli exclusion principle. One can't have two spins simultaneously, can one? He gave her his arm again. "Let's go on to Central Control," he proposed. "That's right behind the people section."

"You know, I can't get over it," she told him softly. "This miracle you've wrought. I've never been more proud of being human."

"Is this your first long space trip?"

"Yes. I was stationed at Port Colorado before the new Administration reshuffled armed service assignments."

"They did? How come?"

"I don't know. Well, that is, during the election campaign the Social Justice Party did talk a lot about old-line officers who were too hidebound to carry out modern policies effectively. But it sounded rather silly to me."

Warburton compressed his lips. "I do not believe it is proper for service officers to discuss political issues publicly," he said like a machine gun.

Ellen flushed. "S-sorry, commander."

Blades felt a helpless anger on her account. He wasn't sure why. What was she to him? He'd probably never see her again. A hell of an attractive target, to be sure; and after so much celibacy he was highly vulnerable; but did she really matter?

He turned his back on Warburton and his eyes on her—a five thousand per cent improvement—and diverted her from her embarrassment by asking, "Are you from Colorado, then, Miss Ziska?"

"Oh, no. Toronto."

"How'd you happen to join the Navy, if I may make so bold?"

"Gosh, that's hard to say. But I guess mostly I felt so crowded at home. So, pigeonholed. The world seemed to be nothing but neat little pigeonholes."

"Uh-huh. Same here. I was also a square pigeon in a round hole." She laughed. "Luckily," he added, "Space is too big for compartments."

Her agreement lacked vigor. The Navy must have been a disappointment to her. But she couldn't very well say so in front of her shipmates.

Hm-m-m . . . if she could be gotten away from them—"How long will you be here?" he inquired. His pulse thuttered.

"We haven't been told," she said.

"Some work must be done on the missile launchers," Warburton said. "That's best carried out here, where extra facilities are available if we need them. Not that I expect we will." He paused. "I hope we won't interfere with your own operations."

"Far from it." Blades beamed at Ellen. "Or, more accurately, this kind of interference I don't mind in the least."

She blushed and her eyelids fluttered. Not that she was a fluffhead, he realized. But to avoid incidents, Navy regulations enforced an inhuman correctness between personnel of opposite sexes. After weeks in the black, meeting a man who could pay a compliment without risking court-martial must be like a shot of adrenalin. Better and better!

"Are you sure?" Warburton persisted. "For instance, won't we be in the way when the next ship comes from Jupiter?"

"She'll approach the opposite end of the asteroid," Blades said. "Won't stay long, either."

"How long?"

"One watch, so the crew can relax a bit among those of us who're off duty. It'd be a trifle longer if we didn't happen to have an empty bag at the moment. But never very long. Even running under thrust the whole distance, Jupe's a good ways off. They've no time to waste."

"When is the next ship due?"

"The *Pallas Castle* is expected in the second watch from now."

"Second watch. I see." Warburton stalked on with a brooding expression on his Puritan face.

Blades might have speculated about that, but someone asked him why the Station depended on spin for weight. Why not put in an internal field generator, like a ship? Blades explained patiently that an Emett large enough to produce uniform pull through a volume as big as the Sword was rather expensive. "Eventually, when we're a few megabucks ahead of the game—"

"Do you really expect to become rich?" Ellen asked. Her tone was awed. No Earthsider had that chance any more, except for the great corporations. "*Individually* rich?"

"We can't fail to. I tell you, this is a frontier like nothing since the Conquistadores. We could very easily have been wiped out in the first couple of years—financially or physically—by any of a thousand accidents. But now we're too far along for that. We've got it made, Jimmy and I."

"What will you do with your wealth?"

"Live like an old-time sultan," Blades grinned. Then, because it was true as well as because he wanted to shine in her eyes: "Mostly, though, we'll go on to new things. There's so much that needs to be done. Not simply more asteroid mines. We need farms; timber; parks; passenger and cargo liners; every sort of machine. I'd like to try getting at some of that water frozen in the Saturnian System. Altogether, I see no end to the jobs. It's no good our depending on Earth for anything. Too expensive, too chancy. The Belt has to be made completely self-sufficient."

"With a nice rakeoff for Sword Enterprises," Gilbertson scoffed.

"Why, sure. Aren't we entitled to some return?"

"Yes. But not so out of proportion as the Belt com-

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panies seem to expect. They're only using natural resources that rightly belong to the people, and the accumulated skills and wealth of an entire society."

"Huh! The People didn't do anything with the Sword. Jimmy and I and our boys did. No Society was around here grubbing nickel-iron and riding out gravel storms; *we* were."

"Let's leave politics alone," Warburton snapped. But it was mostly Ellen's look of distress which shut Blades up.

To everybody's relief, they reached Central Control about then. It was a complex of domes and rooms, crammed with more equipment than Blades could put a name to. Computers were in Chung's line, not his. He wasn't able to answer all of Warburton's disconcertingly sharp questions.

But in a general way he could. Whirling through vacuum with a load of frail humans and intricate artifacts, the Sword must be at once machine, ecology, and unified organism. Everything had to mesh. A failure in the thermodynamic balance, a miscalculation in supply inventory, a few mirrors perturbed out of proper orbit, might spell Ragnarok. The chemical plant's purifications and syntheses were already a network too large for the human mind to grasp as a whole, and it was still growing. Even where men could have taken charge, automation was cheaper, more reliable, less risky of lives. The computer system housed in Central Control was not only the brain, but the nerves and heart of the Sword.

"Entirely cryotronic, eh?" Warburton commented. "That seems to be the usual practice at the Stations. Why?"

"The least expensive type for us," Blades answered. "There's no problem in maintaining liquid helium here."

Warburton's gaze was peculiarly intense. "Cryotronic systems are vulnerable to magnetic and radiation disturbances."

"Uh-huh. That's one reason we don't have a nuclear power plant. This far from the sun, we don't get enough emission to worry about. The asteroid's mass screens out what little may arrive. I know the TIMM system is used on ships; but if nothing else, the initial cost is more than we want to pay."

"What's TIMM?" inquired the *Altair's* chaplain.

"Thermally Integrated Micro-Miniaturized," Ellen said crisply. "Essentially, ultraminiaturized ceramic-to-metal-seal vacuum tubes running off thermionic generators. They're immune to gamma ray and magnetic pulses, easily shielded against particule radiation, and economical of power." She grinned. "Don't tell me there's nothing about them in Leviticus, Padre!"

"Very fine for a ship's autopilot," Blades agreed. "But as I said, we needn't worry about rad or mag units here, we don't mind sprawling a bit, and as for thermal efficiency, we *want* to waste some heat. It goes to maintain internal temperature."

"In other words, efficiency depends on what you need to effish," Ellen bantered. She grew grave once more and studied him for a while before she mused, "The same person who swung a pick, a couple of years ago, now deals with something as marvelous as this . . ." He forgot about worrying.

But he remembered later, when the gig had left and Chung called him to his office. Avis came too, by request. As she entered, she asked why.

"You were visiting your folks Earthside last year," Chung said. "Nobody else in the Station has been back as recently as that."

"What can I tell you?"

"I'm not sure. Background, perhaps. The feel of the place. We don't really know, out in the Belt, what's going on there. The beamcast news is hardly a trickle. Besides, you have more common sense in your left little toe than that big mick yonder has in his entire copperplated head."

They seated themselves in the cobwebby low-gee chairs around Chung's desk. Blades took out his pipe and filled the bowl with his tobacco ration for today. Wouldn't it be great, he thought dreamily, if this old briar turned out to be an Aladdin's lamp, and the smoke condensed into a blonde she-Canadian—?

"Wake up, will you?" Chung barked.

"Huh?" Blades started. "Oh. Sure. What's the matter? You look like a fish on Friday."

"Maybe with reason. Did you notice anything unusual with that party you were escorting?"

"Yes, indeed."

"What?"

"About one hundred seventy-five centimeters tall, yellow hair, blue eyes, and some of the smoothest fourth-order curves I ever—"

"Mike, stop that!" Avis sounded appalled. "This is serious."

"I agree. She'll be leaving in a few more watches."

The girl bit her lip. "You're too old for that mooncalf rot and you know it."

"Agreed again. I feel more like a bull." Blades made pawing motions on the desktop.

"There's a lady present," Chung said.

Blades saw that Avis had gone quite pale. "I'm sorry," he blurted. "I never thought . . . I mean, you've always seemed like—"

"One of the boys," she finished for him in a brittle tone. "Sure. Forget it. What's the problem, Jimmy?"

Chung folded his hands and stared at them. "I can't quite define that," he answered, word by careful word. "Perhaps I've simply gone spacedizzy. But when we called on Admiral Hulse, and later when he called on us, didn't you get the impression of, well, wariness? Didn't he seem to be watching and probing, every minute we were together?"

"I wouldn't call him a cheerful sort," Blades nodded. "Stiff as molasses on Pluto. But I suppose . . . supposed he's just naturally that way."

Chung shook his head. "It wasn't a normal standoffish-

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ness. You've heard me reminisce about the time I was on Vesta with the North American technical representative, when the Convention was negotiated."

"Yes, I've heard that story a few times," said Avis dryly.

"Remember, that was right after the Europa Incident. We'd come close to a space war—undeclared, but it would have been nasty. We were still close. Every delegate went to that conference cocked and primed.

"Hulse had the same manner."

A silence fell. Blades said at length, "Well, come to think of it, he did ask some rather odd questions. He seemed to twist the conversation now and then, so he could find out things like our exact layout, emergency doctrine, and so forth. It didn't strike me as significant, though."

"Nor me," Chung admitted. "Taken in isolation, it meant nothing. But these visitors today—Sure, most of them obviously didn't suspect anything untoward. But that Liebknecht, now. Why was he so interested in Central Control? Nothing new or secret there. Yet he kept asking for details like the shielding factor of the walls."

"So did Commander Warburton," Blades remembered. "Also, he wanted to know exactly when the *Pallas* is due, how long she'll stay . . . hm-m-m, yes, whether we have any radio linkage with the outside, like to Ceres or even the nearest Commission base—"

"Did you tell him that we don't?" Avis asked sharply.

"Yes. Shouldn't I have?"

"It scarcely makes any difference," Chung said in a resigned voice. "As thoroughly as they went over the ground, they'd have seen what we do and do not have installed so far."

He leaned forward. "Why are they hanging around?" he asked. "I was handed some story about overhauling the missile system."

"Me, too," Blades said.

"But you don't consider a job complete till it's been tested. And you don't fire a test shot, even a dummy, this close to a Station. Besides, what could have gone wrong? I can't see a ship departing Earth orbit for a long cruise without everything being in order. And they didn't mention any meteorites, any kind of trouble, en route. Furthermore, why do the work here? The Navy yard's at Ceres. We can't spare them any decent amount of materials or tools or help."

Blades frowned. His own half-formulated doubts shouldered to the fore, which was doubly unpleasant after he'd been considering Ellen Ziska. "They tell me the international situation at home is O.K.," he offered.

Avis nodded. "What newsfaxes we get in the mail indicate as much," she said. "So why this hanky-panky?" After a moment, in a changed voice: "Jimmy, you begin to scare me a little."

"I scare myself," Chung said.

"Every morning when you debeard," Blades said; but his heart wasn't in it. He shook himself and protested: "Damnation, they're our own countrymen. We're engaged in a lawful business. Why should they do anything to us?"

"Maybe Avis can throw some light on that," Chung suggested.

The girl twisted her fingers together. "Not me," she said. "I'm no politician."

"But you were home not so long ago. You talked with people, read the news, watched the 3V. Can't you at least give an impression?"

"N-no—Well, of course the preliminary guns of the election campaign were already being fired. The Social Justice Party was talking a lot about . . . oh, it seemed so ridiculous that I didn't pay much attention."

"They talked about how the government had been pouring billions and billions of dollars into space, while overpopulation produced crying needs in America's back yard," Chung said. "We know that much, even in the Belt. We know the appropriations are due to be cut, now the Essjays are in. So what?"

"We don't need a subsidy any longer," Blades remarked. "It'd help a lot, but we can get along without if we have to, and personally, I prefer that. Less government money means less government control."

"Sure," Avis said. "There was more than that involved, however. The Essjays were complaining about the small return on the investment. Not enough minerals coming back to Earth."

"Well, for Jupiter's sake," Blades exclaimed, "what do they expect? We have to build up our capabilities first."

"They even said, some of them, that enough reward never would be gotten. That under existing financial policies, the Belt would go in for its own expansion, use nearly everything it produced for itself and export only a trickle to America. I had to explain to several of my parents' friends that I wasn't really a socially irresponsible capitalist."

"Is that all the information you have?" Chung asked when she fell silent.

"I . . . I suppose so. Everything was so vague. No dramatic events. More of an atmosphere than a concrete thing."

"Still, you confirm my own impression," Chung said. Blades jerked his undisciplined imagination back from the idea of a Thing, with bug eyes and tentacles, cast in reinforced concrete, and listened as his partner summed up:

"The popular feeling at home has turned against private enterprise. You can hardly call a corporate monster like Systemic Developments a private enterprise! The new President and Congress share that mood. We can expect to see it manifested in changed laws and regulations. But what has this got to do with a battleship parked a couple of hundred kilometers from us?"

"If the government doesn't want the asterites to de-

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velop much further—" Blades bit hard on his pipestem. "They must know we have a caviar mine here. We'll be the only city in this entire sector."

"But we're still a baby," Avis said. "We won't be important for years to come. Who'd have it in for a baby?"

"Besides, we're Americans, too," Chung said. "If that were a foreign ship, the story might be different—Wait a minute! Could they be thinking of establishing a new base here?"

"The Convention wouldn't allow," said Blades.

"Treaties can always be renegotiated, or even denounced. But first you have to investigate quietly, find out if it's worth your while."

"Hoo hah, what lovely money that'd mean!"

"And lovely bureaucrats crawling out of every file cabinet," Chung said grimly. "No, thank you. We'll fight any such attempt to the last lawyer. We've got a good basis, too, in our charter. If the suit is tried on Ceres, as I believe it has to be, we'll get a sympathetic court as well."

"Unless they ring in an Earthside judge," Avis warned.

"Yeah, that's possible. Also, they could spring proceedings on us without notice. We've got to find out in advance, so we can prepare. Any chance of pumping some of those officers?"

" 'Fraid not," Avis said. "The few who'd be in the know are safely back on shipboard."

"We could invite 'em here individually," said Blades. "As a matter of fact, I already have a date with Lieutenant Ziska."

"What?" Avis' mouth fell open.

"Yep," Blades said complacently. "End of the next watch, so she can observe the *Pallas* arriving. I'm to fetch her on a scooter." He blew a fat smoke ring. "Look, Jimmy, can you keep everybody off the porch for a while then? Starlight, privacy, soft music on the piccolo—who knows what I might find out?"

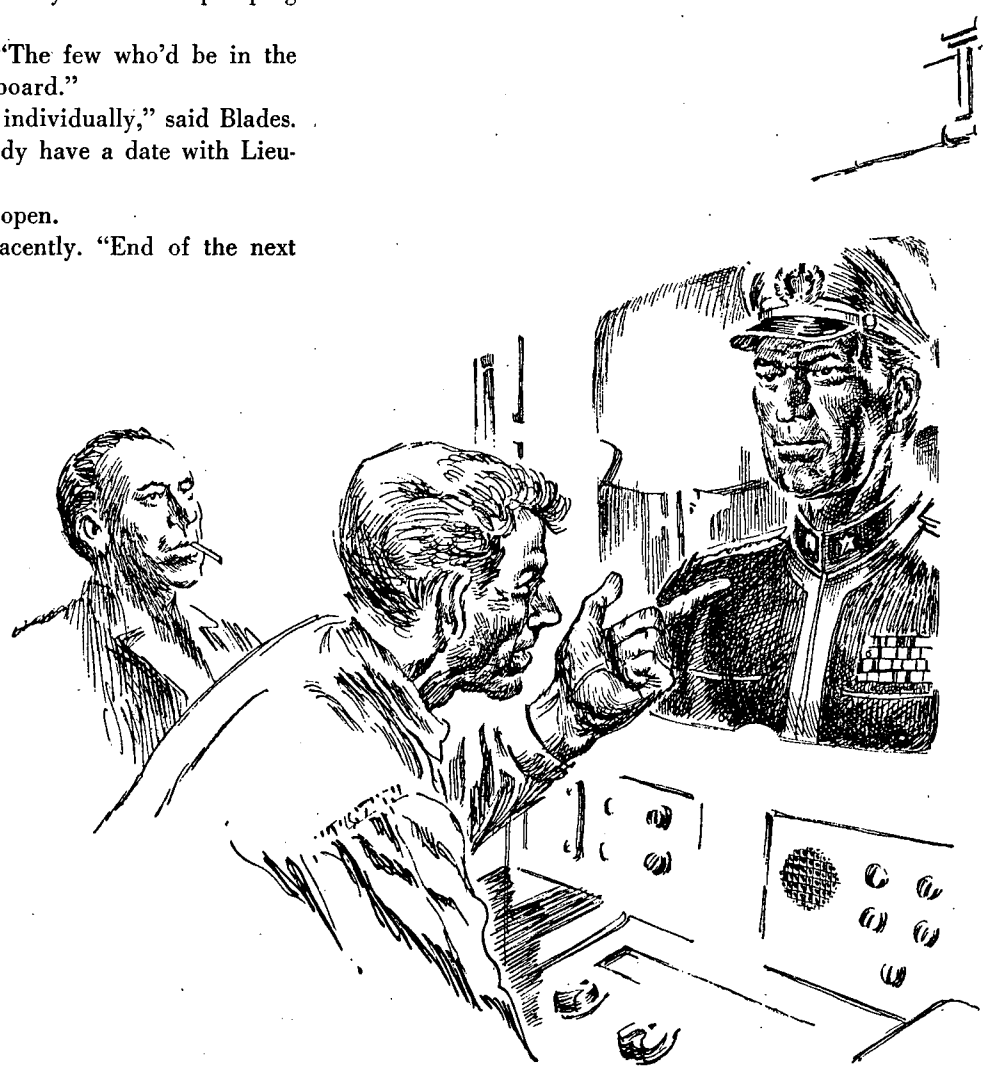
"You won't get anything from *her*," Avis spat. "No secrets or, or anything."

"Still, I look forward to making the attempt. C'mon, pal, pass the word. I'll do as much for you sometime."

"Times like that never seem to come for me," Chung groaned.

"Oh, let him play around with his suicide blonde," Avis said furiously. "We others have work to do. I . . . I'll tell you what, Jimmy. Let's not eat in the mess tonight. I'll draw our rations and fix us something special in your cabin."

A scooter was not exactly the ideal steed for a knight to convey his lady. It amounted to little more than three saddles and a locker, set atop an accumulator-powered gyrogravitic engine, sufficient to lift you off an asteroid and run at low acceleration. There were no navigating



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instruments. You locked the autopilot's radar-gravitic sensors onto your target object and it took you there, avoiding any bits of debris which might pass near; but you must watch the distance indicator and press the deceleration switch in time. If the 'pilot was turned off, free maneuver became possible, but that was a dangerous thing to try before you were almost on top of your destination. Stereoscopic vision fails beyond six or seven meters, and the human organism isn't equipped to gauge cosmic momenta.

Nevertheless, Ellen was enchanted. "This is like a dream," her voice murmured in Blades' earplug. "The whole universe, on every side of us. I could almost reach out and pluck those stars."

"You must have trained in powered spacesuits at the Academy," he said for lack of a more poetic rejoiner.

"Yes, but that's not the same. We had to stay near Luna's night side, to be safe from solar particles, and it bit a great chunk out of the sky. And then everything was so—regulated, disciplined—we did what we were ordered to do, and that was that. Here I feel free. You can't imagine how free." Hastily: "Do you use this machine often?"

"Well, yes, we have about twenty scooters at the Station. They're the most convenient way of flitting with a load: out to the mirrors to change accumulators, for instance, or across to one of the companion rocks where we're digging some ores that the Sword doesn't have. That kind of work." Blades would frankly rather have had her behind him on a motorskimmer, hanging on as they careened through a springtime countryside. He was glad when they reached the main forward air lock and debarked.

He was still gladder when the suits were off. Lieutenant Ziska in dress uniform was stunning, but Ellen in civvies, a fluffy low-cut blouse and close-fitting slacks, was a hydrogen blast. He wanted to roll over and pant, but settled for saying, "Welcome back" and holding her hand rather longer than necessary.

With a shy smile, she gave him a package. "I drew this before leaving," she said. "I thought, well, your life is so austere—"

"A demi of Sandeman," he said reverently. "I won't tell you you shouldn't have, but I will tell you you're a sweet girl."

"No, really." She flushed. "After we've put you to so much trouble."

"Let's go crack this," he said. "The *Pallas* has called in, but she won't be visible for a while yet."

They made their way to the verandah, picking up a couple of glasses enroute. Bless his envious heart, Jimmy had warned the other boys off as requested. *I hope Avis cooks him a Cordon Bleu dinner*, Blades thought. *Nice kid, Avis, if she'd quit trying to . . . what? . . . mother me?* He forgot about her, with Ellen to seat by the rail.

The Milky Way turned her hair frosty and glowed in her eyes. Blades poured the port with much ceremony and raised his glass. "Here's to your frequent return," he said.

Her pleasure dwindled a bit. "I don't know if I should drink to that. We aren't likely to be back, ever."

"Drink anyway. Gling, glang, gloria!" The rims tinkled together. "After all," said Blades, "this isn't the whole universe. We'll both be getting around. See you on Luna?"

"Maybe."

He wondered if he was pushing matters too hard. She didn't look at ease. "Oh, well," he said, "if nothing else, this has been a grand break in the monotony for us. I don't wish the Navy ill, but if trouble had to develop, I'm thankful it developed here."

"Yes—"

"How's the repair work progressing? Slowly, I hope."

"I don't know."

"You should have some idea, being in QM."

"No supplies have been drawn."

Blades stiffened.

"What's the matter?" Ellen sounded alarmed.

"Huh?" *A fine conspirator I make, if she can see my emotions on me in neon capitals!* "Nothing. Nothing. It just seemed a little strange, you know. Not taking any replacement units."

"I understand the work is only a matter of making certain adjustments."

"Then they should've finished a lot quicker, shouldn't they?"

"Please," she said unhappily. "Let's not talk about it. I mean, there are such things as security regulations."

Blades gave up on that tack. But Chung's idea might be worth probing a little. "Sure," he said. "I'm sorry, I didn't mean to pry." He took another sip as he hunted for suitable words. A beautiful girl, a golden wine . . . and vice versa . . . why couldn't he simply relax and enjoy himself? Did he have to go fretting about what was probably a perfectly harmless conundrum? . . . Yes. However, recreation might still combine with business.

"Permit me to daydream," he said, leaning close to her. "The Navy's going to establish a new base here, and the *Altair* will be assigned to it."

"Daydream indeed!" she laughed, relieved to get back to a mere flirtation. "Ever hear about the Convention of Vesta?"

"Treaties can be renegotiated," Blades plagiarized.

"What do we need an extra base for? Especially since the government plans to spend such large sums on social welfare. They certainly don't want to start an arms race besides."

Blades nodded. *Jimmy's notion did seem pretty thin*, he thought with a slight chill, *and now I guess it's completely whiffed.* Mostly to keep the conversation going, he shrugged and said, "My partner—and me, too, aside from the privilege of your company—wouldn't have wanted it

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anyhow. Not that we're unpatriotic, but there are plenty of other potential bases, and we'd rather keep government agencies out of here."

"Can you, these days?"

"Pretty much. We're under a new type of charter, as a private partnership. The first such charter in the Belt, as far as I know, though there'll be more in the future. The Bank of Ceres financed us. We haven't taken a nickel of federal money."

"Is that possible?"

"Just barely. I'm no economist, but I can see how it works. Money represents goods and labor. Hitherto those have been in mighty short supply out here. Government subsidies made up the difference, enabling us to buy from Earth. But now the asterites have built up enough population and industry that they have some capital surplus of their own, to invest in projects like this."

"Even so, frankly, I'm surprised that two men by themselves could get such a loan. It must be huge. Wouldn't the bank rather have lent the money to some corporation?"

"To tell the truth, we have friends who pulled wires for us. Also, it was done partly on ideological grounds. A lot of asterites would like to see more strictly home-grown enterprises, not committed to anyone on Earth. That's the only way we can grow. Otherwise our profits —our net production, that is—will continue to be siphoned off for the mother country's benefit."

"Well," Ellen said with some indignation, "that was the whole reason for planting asteroid colonies. You can't expect us to set you up in business, at enormous cost to ourselves—things we might have done at home—and get nothing but 'Ta' in return."

"Never fear, we'll repay you with interest," Blades said. "But whatever we make from our own work, over and above that, ought to stay here with us."

She grew angrier. "Your kind of attitude is what provoked the voters to elect Social Justice candidates."

"Nice name, that," mused Blades. "Who can be against social justice? But you know, I think I'll go into politics myself. I'll organize the North American Motherhood Party."

"You wouldn't be so flippant if you'd go see how people have to live back there."

"As bad as here? *Whew!*"

"Nonsense. You know that isn't true. But bad enough. And you aren't going to stick in these conditions. Only a few hours ago, you were bragging about the millions you intend to make."

"Millions *and* millions, if my strength holds out," leered Blades, thinking of the alley in Aresopolis. But he decided that that was then and Ellen was now, and what had started as a promising little party was turning into a dismal argument about politics.

"Let's not fight," he said. "We've got different orientations, and we'd only make each other mad. Let's discuss our next bottle instead . . . at the Coq d'Or in Paris, shall we say? Or Morraine's in New York."

She calmed down, but her look remained troubled. "You're right, we are different," she said low. "Isolated, living and working under conditions we can hardly imagine on Earth—and you can't really imagine our problems—yes, you're becoming another people. I hope it will never go so far that—No. I don't want to think about it." She drained her glass and held it out for a refill, smiling. "Very well, sir, when do you next plan to be in Paris?"

An exceedingly enjoyable while later, the time came to go watch the *Pallas Castle* maneuver in. In fact, it had somehow gotten past that time, and they were late; but they didn't hurry their walk aft. Blades took Ellen's hand, and she raised no objection. Schoolboyish, no doubt—however, he had reached the reluctant conclusion that for all his dishonorable intentions, this affair wasn't likely to go beyond the schoolboy stage. Not that he wouldn't keep trying.

As they glided through the refining and synthesizing section, which filled the broad half of the asteroid, the noise of pumps and regulators rose until it throbbed in their bones. Ellen gestured at one of the pipes which crossed the corridor overhead. "Do you really handle that big a volume at a time?" she asked above the racket.

"No," he said. "Didn't I explain before? The pipe's thick because it's so heavily armored."

"I'm glad you don't use that dreadful word 'cladded.' But why the armor? High pressure?"

"Partly. Also, there's an inertrans lining. Jupiter gas is hellishly reactive at room temperature. The metallic complexes especially; but think what a witch's brew the stuff is in every respect. Once it's been refined, of course, we have less trouble. That particular pipe is carrying it raw."

They left the noise behind and passed on to the approach control dome at the receptor end. The two men on duty glanced up and immediately went back to their instruments. Radio voices were staccato in the air. Blades led Ellen to an observation port.

She drew a sharp breath. Outside, the broken ground fell away to space and the stars. The ovoid that was the ship hung against them, lit by the hidden sun, a giant even at her distance but dwarfed by the balloon she towed. As that bubble tried ponderously to rotate, rainbow gleams ran across it, hiding and then revealing the constellations. Here, on the asteroid's axis, there was no weight, and one moved with underwater smoothness, as if disembodied. "Oh, a fairy tale," Ellen sighed.

Four sparks flashed out of the boat blisters along the ship's hull. "Scoopships," Blades told her. "They haul the cargo in, being so much more maneuverable. Actually, though, the mother vessel is going to park her load in orbit, while those boys bring in another one . . . see, there it comes into sight. We still haven't got the capacity to keep up with our deliveries."

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"How many are there? Scoopships, that is."

"Twenty, but you don't need more than four for this job. They've got terrific power. Have to, if they're to dive from orbit down into the Jovian atmosphere, ram themselves full of gas, and come back. There they go."

The *Pallas Castle* was wrestling the great sphere she had hauled from Jupiter into a stable path computed by Central Control. Meanwhile the scoopships, small only by comparison with her, locked onto the other balloon as it drifted close. Energy poured into their drive fields. Spiraling downward, transparent globe and four laboring spacecraft vanished behind the horizon. The *Pallas* completed her own task, disengaged her towbars, and dropped from view, headed for the dock.

The second balloon rose again, like a huge glass moon on the opposite side of the Sword. Still it grew in Ellen's eyes, kilometer by kilometer of approach. So much mass wasn't easily handled, but the braking curve looked disdainfully smooth. Presently she could make out the scoopships in detail, elongated teardrops with the intake gates yawning in the blunt forward end, cockpit canopies raised very slightly above.

Instructions rattled from the men in the dome. The balloon veered clumsily toward the one free receptor. A derricklike structure released one end of a cable, which streamed skyward. Things that Ellen couldn't quite follow in this tricky light were done by the four tugs, mechanisms of their own extended to make their tow fast to the cable.

They did not cast loose at once, but continued to drag a little, easing the impact of centrifugal force. Nonetheless a slight shudder went through the dome as slack was taken up. Then the job was over. The scoopships let go and flitted off to join their mother vessel. The balloon was winched inward. Spacesuited men moved close, preparing to couple valves together.

"And eventually," Blades said into the abrupt quietness, "that cargo will become food, fabric, vitryl, plastiboard, reagents, fuels, a hundred different things. That's what we're here for."

"I've never seen anything so wonderful," Ellen said raptly. He laid an arm around her waist.

The intercom chose that precise moment to blare: "Attention! Emergency! All hands to emergency stations! Blades, get to Chung's office on the double! All hands to emergency stations!"

Blades was running before the siren had begun to howl.

Rear Admiral Barclay Hulse had come in person. He stood as if on parade, towering over Chung. The asterite was red with fury. Avis Page crouched in a corner, her eyes terrified.

Blades barreled through the doorway and stopped hardly short of a collision. "What's the matter?" he puffed.

"Plenty!" Chung snarled. "These incredible thumble-fumbed oafs —" His voice broke. *When he gets mad, it means something!*

Hulse nailed Blades with a glance. "Good day, sir," he clipped. "I have had to report a regrettable accident which will require you to evacuate the Station. Temporarily, I hope."

"Huh?"

"As I told Mr. Chung and Miss Page, a nuclear missile has escaped us. If it explodes, the radiation will be lethal, even in the heart of the asteroid."

"What . . . what—" Blades could only gobble at him.

"Fortunately, the *Pallas Castle* is here. She can take your whole complement aboard and move to a safe distance while we search for the object."

"How the *devil?*"

Hulse allowed himself a look of exasperation. "Evidently I'll have to repeat myself to you. Very well. You know we have had to make some adjustments on our launchers. What you did not know was the reason. Under the circumstances, I think it's permissible to tell you that several of them have a new and secret, experimental control system. One of our missions on this cruise was to carry out field tests. Well, it turned out that the system is still full of, ah, bugs. Gunnery Command has had endless trouble with it, has had to keep tinkering the whole way from Earth.

"Half an hour ago, while Commander Warburton was completing a reassembly—lower ranks aren't allowed in the test turrets—something happened. I can't tell you my guess as to what, but if you want to imagine that a relay got stuck, that will do for practical purposes. A missile was released under power. Not a dummy—the real thing. And release automatically arms the war head."

The news was like a hammerblow. Blades spoke an obscenity. Sweat sprang forth under his arms and trickled down his ribs.

"No such thing was expected," Hulse went on. "It's an utter disaster, and the designers of the system aren't likely to get any more contracts. But as matters were, no radar fix was gotten on it, and it was soon too far away for gyrogravitic pulse detection. The thrust vector is unknown. It could be almost anywhere now.

"Well, naval missiles are programmed to reverse acceleration if they haven't made a target within a given time. This one should be back in less than six hours. If it first detects our ship, everything is all right. It has optical recognition circuits that identify any North American warcraft by type, disarm the war head, and steer it home. But, if it first comes within fifty kilometers of some other mass—like this asteroid or one of the companion rocks—it will detonate. We'll make every effort to intercept, but space is big. You'll have to take your people to a safe distance. They can come back even after a blast, of course. There's no concussion in vacuum, and the fireball won't reach here. It's principally an antipersonnel weapon. But you must not be within the lethal radius of radiation."

"The hell we can come back!" Avis cried.

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"I beg your pardon?" Hulse said.

"You imbecile! Don't you know Central Control here is cryotronic?"

Hulse did not flicker an eyelid. "So it is," he said expressionlessly. "I had forgotten."

Blades mastered his own shock enough to grate: "Well, we sure haven't. If that thing goes off, the gamma burst will kick up so many minority carriers in the transistors that the *p*-type crystals will act *n*-type, and the *n*-type act *p*-type, for a whole couple of microseconds. Every one of 'em will flip simultaneously! The computers' memory and program data systems will be scrambled beyond hope of reorganization."

"Magnetic pulse, too," Chung said. "The fireball plasma will be full of inhomogeneities moving at several per cent of light speed. Their electromagnetic output, hitting our magnetic core units, will turn them from super to ordinary conduction. Same effect, total computer amnesia. We haven't got enough shielding against it. Your TIMM systems can take that kind of a beating. Ours can't!"

"Very regrettable," Hulse said. "You'd have to reprogram everything—"

"Reprogram what?" Avis retorted. Tears started forth in her eyes. "We've told you what sort of stuff our chemical plant is handling. We can't shut it down on that short notice. It'll run wild. There'll be sodium explosions, hydrogen and organic combustion, n-n-nothing left here but wreckage!"

Hulse didn't unbend a centimeter. "I offer my most sincere apologies. If actual harm does occur, I'm sure the government will indemnify you. And, of course, my command will furnish what supplies may be needed for the *Pallas Castle* to transport you to the nearest Commission base. At the moment, though, you can do nothing but evacuate and hope we will be able to intercept the missile."

Blades knotted his fists. A sudden comprehension rushed up in him and he bellowed, "There isn't going to be an interception! This wasn't an accident!"

Hulse backed a step and drew himself even straighter. "Don't get overwrought," he advised.

"You louse-bitten, egg-sucking, bloated faggot-porter! How stupid do you think we are? As stupid as your Ess-jay bosses? By heaven, we're staying! Then see if you have the nerve to murder a hundred people!"

"Mike . . . Mike—" Avis caught his arm.

Hulse turned to Chung. "I'll overlook that unseemly outburst," he said. "But in light of my responsibilities and under the provisions of the Constitution, I am hereby putting this asteroid under martial law. You will have all personnel aboard the *Pallas Castle* and at a minimum distance of a thousand kilometers within four hours of this moment, or be subject to arrest and trial. Now I have to get back and commence operations. The *Altair* will maintain radio contact with you. Good day." He bowed curtly, spun on his heel, and clacked from the room.

Blades started to charge after him. Chung caught his free arm. Together he and Avis dragged him to a stop. He stood cursing the air ultraviolet until Ellen entered.

"I couldn't keep up with you," she panted. "What's happened, Mike?"

The strength drained from Blades. He slumped into a chair and covered his face.

Chung explained in a few harsh words. "Oh-h-h," Ellen gasped. She went to Blades and laid her hands on his shoulders. "My poor Mike!"

After a moment she looked at the others. "I should report back, of course," she said, "but I won't be able to before the ship accelerates. So I'll have to stay with you till afterward. Miss Page, we left about half a bottle of wine on the verandah. I think it would be a good idea if you went and got it."

Avis bridled. "And why not you?"

"This is no time for personalities," Chung said. "Go on, Avis. You can be thinking what records and other paper we should take, while you're on your way. I've got to organize the evacuation. As for Miss Ziska, well, Mike needs somebody to pull him out of his dive."

"Her?" Avis wailed, and fled.

Chung sat down and flipped his intercom to Phone Central. "Get me Captain Janichevski aboard the *Pallas*," he ordered. "Hello, Adam? About that general alarm—"

Blades raised a haggard countenance toward Ellen's. "You better clear out, along with the women and any men who don't want to stay," he said. "But I think most of them will take the chance. They're on a profit-sharing scheme, they stand to lose too much if the place is ruined."

"What do you mean?"

"It's a gamble, but I don't believe Hulse's sealed orders extend to murder. If enough of us stay put, he'll have to catch that thing. He jolly well knows its exact trajectory."

"You forget we're under martial law," Chung said, aside to him. "If we don't go freely, he'll land some PP's and march us off at gunpoint. There isn't any choice. We've had the course."

"I don't understand," Ellen said shakily.

Chung went back to his intercom. Blades fumbled out his pipe and rolled it empty between his hands. "That missile was shot off on purpose," he said.

"What? No, you must be sick, that's impossible!"

"I realize you didn't know about it. Only three or four officers have been told. The job had to be done very, very secretly, or there'd be a scandal, maybe an impeachment. But it's still sabotage."

She shrank from him. "You're not making sense."

"Their own story doesn't make sense. It's ridiculous. A new missile system wouldn't be sent on a field trial clear to the Belt before it'd had enough tests closer to home to get the worst bugs out. A war-head missile wouldn't be stashed anywhere near something so unreliable, let alone be put under its control. The testing ship wouldn't hang around a civilian Station while her gun-

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nery chief tinkered. And Hulse, Warburton, Liebknecht, they were asking in *such* detail about how radiation-proof we are."

"I can't believe it. Nobody will."

"Not back home. Communication with Earth is so sparse and garbled. The public will only know there was an accident; who'll give a hoot about the details? We couldn't even prove anything in an asteroid court. The Navy would say, 'Classified information!' and that'd stop the proceedings cold. Sure, there'll be a board of inquiry —composed of naval officers. Probably honorable men, too. But what are they going to believe, the sworn word of their Goddard House colleague, or the rantings of an asterite bum?"

"Mike, I know this is terrible for you, but you've let it go to your head." Ellen laid a hand over his. "Suppose the worst happens. You'll be compensated for your loss."

"Yeah. To the extent of our personal investment. The Bank of Ceres still has nearly all the money that was put in. We didn't figure to have them paid off for another ten years. They, or their insurance carrier, will get the indemnity. And after our fiasco, they won't make us a new loan. They were just barely talked into it, the first time around. I daresay Systemic Developments will make them a nice juicy offer to take this job over."

Ellen colored. She stamped her foot. "You're talking like a paranoiac. Do you really believe the government of North America would send a battleship clear out here to do you dirt?"

"Not the whole government. A few men in the right positions is all that's necessary. I don't know if Hulse was bribed or talked into this. But probably he agreed as a duty. He's the prim type."

"A duty—to destroy a North American business?"

Chung finished at the intercom in time to answer: "Not permanent physical destruction, Miss Ziska. As Mike suggested, some corporation will doubtless inherit the Sword and repair the damage. But a private, purely asterite business . . . yes, I'm afraid Mike's right. We are the target."

"In mercy's name, why?"

"From the highest motives, of course," Chung sneered bitterly. "You know what the Social Justice Party thinks of private capitalism. What's more important, though, is that the Sword is the first Belt undertaking not tied to Mother Earth's apron strings. We have no commitments to anybody back there. We can sell our output wherever we like. It's notorious that the asterites are itching to build up their own self-sufficient industries. Quite apart from sentiment, we can make bigger profits in the Belt than back home, especially when you figure the cost of sending stuff in and out of Earth's gravitational well. So certainly we'd be doing most of our business out here.

"Our charter can't simply be revoked. First a good many laws would have to be revised, and that's politically impossible. There is still a lot of individualist sentiment in North America, as witness the fact that businesses do get launched and that the Essjays did have a hard campaign to get elected. What the new government wants is something like the Eighteenth Century English policy toward America. Keep the colonies as a source of raw materials and as a market for manufactured goods, but don't let them develop a domestic industry. You can't come right out and say that, but you can let the situation develop naturally.

"Only . . . here the Sword is, obviously bound to grow rich and expand in every direction. If we're allowed to develop, to reinvest our profits, we'll become the nucleus of independent asterite enterprise. If, on the other hand, we're wiped out by an unfortunate accident, there's no nucleus; and a small change in the banking laws is all that's needed to prevent others from getting started. Q.E.D."

"I daresay Hulse does think he's doing his patriotic duty," said Blades. "He wants to guarantee North America our natural resources—in the long run, maybe, our allegiance. If he has to commit sabotage, too bad, but it won't cost him any sleep."

"No!" Ellen almost screamed.

Chung sagged in his chair. "We're very neatly trapped," he said like an old man. "I don't see any way out. Think you can get to work now, Mike? You can assign group leaders for the evacuation—"

Blades jumped erect. "I can fight!" he growled.

"With what? Can openers?"

"You mean you're going to lie down and let them break us?"

Avis came back. She thrust the bottle into Blades' hands as he paced the room. "Here you are," she said in a distant voice.

He held it out toward Ellen. "Have some," he invited.

"Not with you . . . you subversive!"

Avis brightened noticeably, took the bottle and raised it. "Then here's to victory," she said, drank, and passed it to Blades.

He started to gulp; but the wine was too noble, and he found himself savoring its course down his throat. *Why*, he thought vaguely, *do people always speak with scorn about Dutch courage? The Dutch have real guts. They fought themselves free of Spain and free of the ocean itself; when the French or Germans came, they made the enemy sea their ally—*

The bottle fell from his grasp. In the weak acceleration, it hadn't hit the floor when Avis rescued it. "Gimme that, you big butterfingers," she exclaimed. Her free hand clasped his arm. "Whatever happens, Mike," she said to him, "we're not quitting."

Still Blades stared beyond her. His fists clenched and unclenched. The noise of his breathing filled the room. Chung looked around in bewilderment; Ellen watched with waxing horror; Avis' eyes kindled.

"Holy smoking seegars," Blades whispered at last. "I really think we can swing it."

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Captain Janichevski recoiled. "You're out of your skull!"

"Probably," said Blades. "Fun, huh?"

"You can't do this."

"We can try."

"Do you know what you're talking about? Insurrection, that's what. Quite likely piracy. Even if your scheme worked, you'd spend the next ten years in Rehab—at least."

"Maybe, provided the matter ever came to trial. But it won't."

"That's what you think. You're asking me to compound the felony, and misappropriate the property of my owners to boot." Janichevski shook his head. "Sorry, Mike. I'm sorry as hell about this mess. But I won't be party to making it worse."

"In other words," Blades replied, "you'd rather be party to sabotage. I'm proposing an act of legitimate self-defense."

"*If* there actually is a conspiracy to destroy the Station."

"Adam, you're a spaceman. You know how the Navy operates. Can you swallow that story about a missile getting loose by accident?"

Janichevski bit his lip. The sounds from outside filled the captain's cabin, voices, footfalls, whirr of machines and clash of doors, as the *Pallas Castle* readied for departure. Blades waited.

"You may be right," said Janichevski at length, wretchedly. "Though why Hulse should jeopardize his career—"

"He's not. There's a scapegoat groomed back home, you can be sure. Like some company that'll be debarred from military contracts for a while . . . and get nice fat orders in other fields. I've kicked around the System enough to know how that works."

"If you're wrong, though . . . if this is an honest blunder . . . then you risk committing treason."

"Yeah. I'll take the chance."

"Not I. No. I've got a family to support," Janichevski said.

Blades regarded him bleakly. "If the Essjays get away with this stunt, what kind of life will your family be leading, ten years from now? It's not simply that we'll be high-class peons in the Belt. But tied hand and foot to a shortsighted government, how much progress will we be able to make? Other countries have colonies out here too, remember, and some of them are already giving their people a freer hand than we've got. Do you want the Asians, or the Russians, or even the Europeans, to take over the asteroids?"

"I can't make policy."

"In other words, mama knows best. Believe, obey, anything put out by some bureaucrat who never set foot beyond Luna. Is that your idea of citizenship?"

"You're putting a mighty fine gloss on baling yourself out!" Janichevski flared.

"Sure, I'm no idealist. But neither am I a slave." Blades hesitated. "We've been friends too long, Adam, for me to try bribing you. But if worst comes to worst, we'll cover for you . . . somehow . . . and if contrariwise we win, then we'll soon be hiring captains for our own ships and you'll get the best offer any spaceman ever got."

"No. Scram. I've work to do."

Blades braced himself. "I didn't want to say this. But I've already informed a number of my men. They're as mad as I am. They're waiting in the terminal. A monkey wrench or a laser torch makes a pretty fair weapon. We can take over by force. That'll leave you legally in the clear. But with so many witnesses around, you'll have to prefer charges against us later on."

Janichevski began to sweat.

"We'll be sent up," said Blades. "But it will still have been worth it."

"Is it really that important to you?"

"Yes. I admit I'm no crusader. But this is a matter of principle."

Janichevski stared at the big redhaired man for a long while. Suddenly he stiffened. "O.K. On that account, and no other, I'll go along with you."

Blades wobbled on his feet, near collapse with relief. "Good man!" he croaked.

"But I will not have any of my officers or crew involved."

Blades rallied and answered briskly, "You needn't. Just issue orders that my boys are to have access to the scoopships. They can install the equipment, jockey the boats over to the full balloons, and even couple them on."

Janichevski's fears had vanished once he made his decision, but now a certain doubt registered. "That's a pretty skilled job."

"These are pretty skilled men. It isn't much of a maneuver, not like making a Jovian sky dive."

"Well, O.K., I'll take your word for their ability. But suppose the *Altair* spots those boats moving around?"

"She's already several hundred kilometers off, and getting farther away, running a search curve which I'm betting my liberty—and my honor; I certainly don't want to hurt my own country's Navy—I'm betting that search curve is guaranteed not to find the missile in time. They'll spot the *Pallas* as you depart—oh, yes, our people will be aboard as per orders—but no finer detail will show in so casual an observation."

"Again, I'll take your word. What else can I do to help?"

"Nothing you weren't doing before. Leave the piratics to us. I'd better get back." Blades extended his hand. "I haven't got the words to thank you, Adam."

Janichevski accepted the shake. "No reason for thanks. You dragooned me." A grin crossed his face. "I must confess, though, I'm not sorry you did."

Blades left. He found his gang in the terminal, two dozen engineers and rockjacks clumped tautly together.

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"What's the word?" Carlos Odonaju shouted.

"Clear track," Blades said. "Go right aboard."

"Good. Fine. I always wanted to do something vicious and destructive," Odonaju laughed.

"The idea is to prevent destruction," Blades reminded him, and proceeded toward the office.

Avis met him in Corridor Four. Her freckled countenance was distorted by a scowl. "Hey, Mike, wait a minute," she said, low and hurriedly. "Have you seen La Ziska?"

"The leftenant? Why, no. I left her with you, remember, hoping you could calm her down."

"Uh-huh. She was incandescent mad. Called us a pack of bandits and—But then she started crying. Seemed to break down completely. I took her to your cabin and went back to help Jimmy. Only, when I checked there a minute ago, she was gone."

"What? Where?"

"How should I know? But that she-devil's capable of anything to wreck our chances."

"You're not being fair to her. She's got an oath to keep."

"All right," said Avis sweetly. "Far be it from me to prevent her fulfilling her obligations. Afterward she may even write you an occasional letter. I'm sure that'll brighten your Rehab cell no end."

"What can she do?" Blades argued, with an uneasy sense of whistling in the dark. "She can't get off the asteroid without a scooter, and I've already got Sam's gang working on all the scooters."

"Is there no other possibility? The radio shack?"

"With a man on duty there. That's out." Blades patted the girl's arm.

"O.K., I'll get back to work. But . . . I'll be so glad when this is over, Mike!"

Looking into the desperate brown eyes, Blades felt a sudden impulse to kiss their owner. But no, there was too much else to do. Later, perhaps. He cocked a thumb upward. "Carry on."

Too bad about Ellen, he thought as he continued toward his office. *What an awful waste, to make a permanent enemy of someone with her kind of looks. And personality—Come off that stick, you clabberhead! She's probably the marryin' type anyway.*

In her shoes, though, what would I do? Not much; they'd pinch my feet. But—damnation, Avis is right. She's not safe to have running around loose. The radio shack? Sparks is not one of the few who've been told the whole story and co-opted into the plan. She could—

Blades cursed, whirled, and ran.

His way was clear. Most of the men were still in their dorms, preparing to leave. He traveled in huge low-gravity leaps.

The radio shack rose out of the surface near the verandah. Blades tried the door. It didn't budge. A chill went through him. He backed across the corridor and charged. The door was only plastiboard—

He hit with a thud and a grunt, and rebounded with a numbed shoulder. But it looked so easy for the cops on 3V!

No time to figure out the delicate art of forcible entry. He hurled himself against the panel, again and again, heedless of the pain that struck in flesh and bone. When the door finally, splinteringly gave way, he stumbled clear across the room beyond, fetched up against an instrument console, recovered his balance, and gaped.

The operator lay on the floor, swearing in a steady monotone. He had been efficiently bound with his own blouse and trousers, which revealed his predilection for maroon shorts with zebra stripes. There was a lump on the back of his head, and a hammer lay close by. Ellen must have stolen the tool and come in here with the thing behind her back. The operator would have had no reason to suspect her.

She had not left the sender's chair, not even while the door was under attack. Only a carrier beam connected the Sword with the *Altair*. She continued doggedly to fumble with dials and switches, trying to modulate it and raise the ship.

"Praises be . . . you haven't had advanced training . . . in radio," Blades choked. "That's . . . a long-range set . . . pretty special system—" He weaved toward her. "Come along, now."

She spat an unladylike refusal.

Theoretically, Blades should have enjoyed the tussle that followed. But he was in poor shape at the outset. And he was a good deal worse off by the time he got her pinioned.

"O.K.," he wheezed. "Will you come quietly?"

She didn't deign to answer, unless you counted her butting him in the nose. He had to yell for help to frog-march her aboard ship.

"*Pallas Castle* calling NASS *Altair*. Come in, *Altair*."

The great ovoid swung clear in space, among a million cold stars. The asteroid had dwindled out of sight. A radio beam flickered across emptiness. Within the hull, the crew and a hundred refugees sat jammed together. The air was thick with their breath and sweat and waiting.

Blades and Chung, seated by the transmitter, felt another kind of thickness, the pull of the internal field. Earth-normal weight dragged down every movement; the enclosed cabin began to feel suffocatingly small. *We'd get used to it again pretty quickly,* Blades thought. *Our bodies would, that is. But our own selves, tied down to Earth forever—no.*

The vision screen jumped to life. "NASS *Altair* acknowledging *Pallas Castle*," said the uniformed figure within.

"O.K., Charlie, go outside and don't let anybody else enter," Chung told his own operator.

The spaceman gave him a quizzical glance, but obeyed. "I wish to report that evacuation of the Sword is now complete," Chung said formally.

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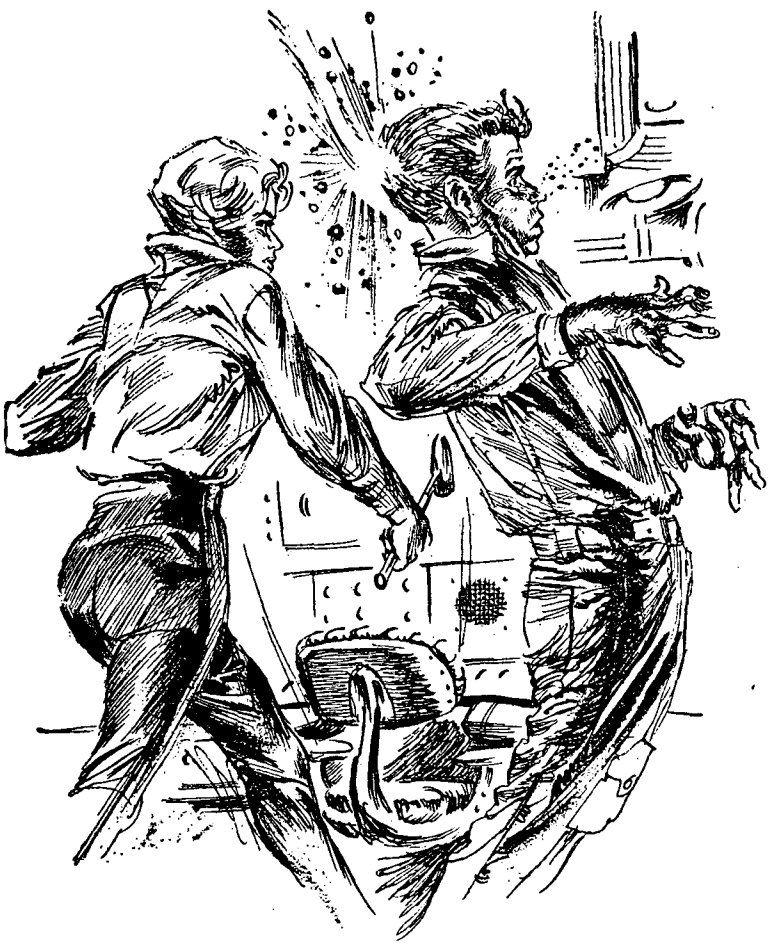

"Very good, sir," the Navy face replied. "I'll inform my superiors."

"Wait, don't break off yet. We have to talk with your captain."

"Sir? I'll switch you over to—"

"None of your damned chains of command," Blades interrupted. "Get me Rear Admiral Hulse direct, toot sweet, or I'll eat out whatever fraction of you he leaves unchewed. This is an emergency. I've got to warn him of an immediate danger only he can deal with."

The other stared, first at Chung's obvious exhaustion, then at the black eye and assorted bruises, scratches, and bites that adorned Blades' visage. "I'll put the message through Channel Red at once, sir." The screen blanked.

"Well, here we go," Chung said. "I wonder how the food in Rehab is these days."

"Want me to do the talking?" Blades asked. Chung wasn't built for times as hectic as the last few hours, and was worn to a nubbin. He himself felt immensely keyed up. He'd always liked a good fight.

"Sure." Chung pulled a crumpled cigarette from his pocket and began to fill the cabin with smoke. "You have a larger stock of rudeness than I."

Presently the screen showed Hulse, rigid at his post on the bridge. "Good day, gentlemen," he said. "What's the trouble?"

"Plenty," Blades answered. "Clear everybody else out of there; let your ship orbit free a while. And seal your circuit."

Hulse reddened. "Who do you think you are?"

"Well, my birth certificate says Michael Joseph Blades. I've got some news for you concerning that top-secret gadget you told us about. You wouldn't want unauthorized personnel listening in."

Hulse leaned forward till he seemed about to fall through the screen. "What's this about a hazard?"

"Fact. The *Altair* is in distinct danger of getting blown to bits."

"Have you gone crazy? Get me the captain of the *Pallas*."

"Very small bits."

Hulse compressed his lips. "All right, I'll listen to you for a short time. You had better make it worth my while."

He spoke orders. Blades scratched his back while he waited for the bridge to be emptied and wondered if there was any chance of a hot shower in the near future.

"Done," said Hulse. "Give me your report."

Blades glanced at the telltale. "You haven't sealed your circuit, admiral."

Hulse said angry words, but complied. "Now will you talk?"

"Sure. This secrecy is for your own protection. You risk court-martial otherwise."

Hulse suppressed a retort.

"O.K., here's the word." Blades met the transmitted glare with an almost palpable crash of eyeballs. "We de-

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cided, Mr. Chung and I, that any missile rig as haywire as yours represents a menace to navigation and public safety. If you can't control your own nuclear weapons, you shouldn't be at large. Our charter gives us local authority as peace officers. By virtue thereof and so on and so forth, we ordered certain precautionary steps taken. As a result, if that war head goes off, I'm sorry to say that NASS *Altair* will be destroyed."

"Are you . . . have you —" Hulse congealed. In spite of everything, he was a competent officer, Blades decided. "Please explain yourself," he said without tone.

"Sure," Blades obliged. "The Station hasn't got any armament, but trust the human race to juryrig that. We commandeered the scoopships belonging to this vessel and loaded them with Jovian gas at maximum pressure. If your missile detonates, they'll dive on you."

Something like amusement tinged Hulse's shocked expression. "Do you seriously consider that a weapon?"

"I seriously do. Let me explain. The ships are orbiting free right now, scattered through quite a large volume of space. Nobody's aboard them. What is aboard each one, though, is an autopilot taken from a scooter, hooked into the drive controls. Each 'pilot has its sensors locked onto your ship. You can't maneuver fast enough to shake off radar beams and mass detectors. You're the target object, and there's nothing to tell those idiot computers to decelerate as they approach you.

"Of course, no approach is being made yet. A switch has been put in every scooter circuit, and left open. Only the meteorite evasion units are operative right now. That is, if anyone tried to lay alongside one of those scoopships, he'd be detected and the ship would skitter away. Remember, a scoopship hasn't much mass, and she does have engines designed for diving in and out of Jupe's gravitational well. She can out-accelerate either of our vessels, or any boat of yours, and out-dodge any of your missiles. You can't catch her."

Hulse snorted. "What's the significance of this farce?"

"I said the autopilots were switched off at the moment, as far as heading for the target is concerned. But each of those switches is coupled to two other units. One is simply the sensor box. If you withdraw beyond a certain distance, the switches will close. That is, the 'pilots will be turned on if you try to go beyond range of the beams now locked onto you. The other unit we've installed in every boat is an ordinary two-for-a-dollar radiation meter. If a nuclear weapon goes off, anywhere within a couple of thousand kilometers, the switches will also close. In either of these cases, the scoopships will dive on you.

"You might knock out a few with missiles, before they strike. Undoubtedly you can punch holes in them with laser guns. But that won't do any good, except when you're lucky enough to hit a vital part. Nobody's aboard to be killed. Not even much gas will be lost, in so short a time.

"So to summarize, chum, if that rogue missile explodes, your ship will be struck by ten to twenty scoopships, each crammed full of concentrated Jovian air. They'll pierce that thin hull of yours, but since they're already pumped full beyond the margin of safety, the impact will split them open and the gas will whoosh out. Do you know what Jovian air does to substances like magnesium?

"You can probably save your crew, take to the boats and reach a Commission base. But your nice battleship will be *ganz kaput*. Is your game worth that candle?"

"You're totally insane! Releasing such a thing—"

"Oh, not permanently. There's one more switch on each boat, connected to the meteorite evasion unit and controlled by a small battery. When those batteries run down, in about twenty hours, the 'pilots will be turned off completely. Then we can spot the scoopships by radar and pick 'em up. And you'll be free to leave."

"Do you think for one instant that your fantastic claim of acting legally will stand up in court?"

"No, probably not. But it won't have to. Obviously you can't make anybody swallow your yarn if a *second* missile gets loose. And as for the first one, since it's failed in its purpose, your bosses aren't going to want the matter publicized. It'd embarrass them no end, and serve no purpose except revenge on Jimmy and me—which there's no point in taking, since the Sword would still be privately owned. You check with Earth, admiral, before shooting off your mouth. They'll tell you that both parties to this quarrel had better forget about legal action. Both would lose.

"So I'm afraid your only choice is to find that missile before it goes off."

"And yours? What are your alternatives?" Hulse had gone gray in the face, but he still spoke stoutly.

Blades grinned at him. "None whatsoever. We've burned our bridges. We can't do anything about those scoopships now, so it's no use trying to scare us or arrest us or whatever else may occur to you. What we've done is establish an automatic deterrent."

"Against an, an attempt . . . at sabotage . . . that only exists in your imagination!"

Blades shrugged. "That argument isn't relevant any longer. I do believe the missile was released deliberatly. We wouldn't have done what we did otherwise. But there's no longer any point in making charges and denials. You'd just better retrieve the thing."

Hulse squared his shoulders. "How do I know you're telling the truth?"

"Well, you can send a man to the Station. He'll find the scooters lying gutted. Send another man over here to the *Pallas*. He'll find the scoopships gone. I also took a few photographs of the autopilots being installed and the ships being cast adrift. Go right ahead. However, may I remind you that the fewer people who have an inkling of this little intrigue, the better for all concerned."

Hulse opened his mouth, shut it again, stared from side to side, and finally slumped the barest bit. "Very well," he said, biting off the words syllable by syllable. "I can't

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risk a ship of the line. Of course, since the rogue is still farther away than your deterrent allows the *Altair* to go, we shall have to wait in space a while."

"I don't mind."

"I shall report the full story to my superiors at home . . . but unofficially."

"Good. I'd like them to know that we asterites have teeth."

"Signing off, then."

Chung stirred. "Wait a bit," he said. "We have one of your people aboard, Lieutenant Ziska. Can you send a gig for her?"

"She didn't collaborate with us," Blades added. "You can see the evidence of her loyalty, all over my mug."

"Good girl!" Hulse exclaimed savagely. "Yes, I'll send a boat. Signing off."

The screen blanked. Chung and Blades let out a long, ragged breath. They sat a while trembling before Chung muttered, "That skunk as good as admitted everything."

"Sure," said Blades. "But we won't have any more trouble from him.

Chung stubbed out his cigarette. Poise was returning to both men. "There could be other attempts, though, in the next few years." He scowled. "I think we should arm the Station. A couple of laser guns, if nothing else. We can say it's for protection in case of war. But it'll make our own government handle us more carefully, too."

"Well, you can approach the Commission about it." Blades yawned and stretched, trying to loosen his muscles. "Better get a lot of other owners and supervisors to sign your petition, though." The next order of business came to his mind. He rose. "Why don't you go tell Adam the good news?"

"Where are you bound?"

"To let Ellen know the fight is over."

"Is it, as far as she's concerned?"

"That's what I'm about to find out. Hope I won't need an armored escort." Blades went from the cubicle, past the watchful radioman, and down the deserted passageway beyond.

The cabin given her lay at the end, locked from outside. The key hung magnetically on the bulkhead. Blades unlocked the door and tapped it with his knuckles.

"Who's there?" she called.

"Me," he said. "May I come in?"

"If you must," she said freezingly.

He opened the door and stepped through. The overhead light shimmered off her hair and limned her figure with shadows. His heart bumped. "You, uh, you can come out now," he faltered. "Everything's O.K."

She said nothing, only regarded him from glacier-blue eyes.

"No harm's been done, except to me and Sparks, and we're not mad," he groped. "Shall we forget the whole episode?"

"If you wish."

"Ellen," he pleaded, "I had to do what seemed right to me."

"So did I."

He couldn't find any more words.

"I assume that I'll be returned to my own ship," she said. He nodded. "Then, if you will excuse me, I had best make myself as presentable as I can. Good day, Mr. Blades."

"What's good about it?" he snarled, and slammed the door on his way out.

Avis stood outside the jampacked saloon. She saw him coming and ran to meet him. He made swab-O with his fingers and joy blazed from her. "Mike," she cried, "I'm so happy!"

The only gentlemanly thing to do was hug her. His spirits lifted a bit as he did. She made a nice armful. Not bad looking, either.

"Well," said Amspaugh. "So that's the inside story. How very interesting. I never heard it before."

"No, obviously it never got into any official record," Missy said. "The only announcement made was that there'd been a near accident, that the Station tried to make counter-missiles out of scoopships, but that the quick action of NASS *Altair* was what saved the situation. Her captain was commended. I don't believe he ever got a further promotion, though."

"Why didn't you publicize the facts afterwards?" Lindgren wondered. "When the revolution began, that is. It would've made good propaganda."

"Nonsense," Missy said. "Too much else had happened since then. Besides, neither Mike nor Jimmy nor I wanted to do any cheap emotion-fanning. We knew the asterites weren't any little pink-bottomed angels, nor the people back sunward a crew of devils. There were rights and wrongs on both sides. We did what we could in the war, and hated every minute of it, and when it was over we broke out two cases of champagne and invited as many Earthsiders as we could get to the party. They had a lot of love to carry home for us."

A stillness fell. She took a long swallow from her glass and sat looking out at the stars.

"Yes," Lindgren said finally, "I guess that was the worst, fighting against our own kin."

"Well, I was better off in that respect than some," Missy conceded. "I'd made my commitment so long before the trouble that my ties were nearly all out here. Twenty years is time enough to grow new roots."

"Really?" Orloff was surprised. "I haven't met you often before, Mrs. Blades, so evidently I've had a false impression. I thought you were a more recent immigrant than that."

"Shucks, no," she laughed. "I only needed six months after the *Altair* incident to think things out, resign my commission and catch the next Belt-bound ship. You don't think I'd have let a man like Mike get away, do you?" ■

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"There's absolutely nothing we can pin it down to with any real certainty," Kessler said. "No mechanical defects that we're sure of, no sabotage we can put our finger on, no murder or suicide schemes, nothing! We've put that plane back together so perfectly that it could almost fly again! We've got dossiers an inch thick on practically everybody who was aboard, crew and passengers. We've done six months' work and we don't have one single positive answer. The newspapers were yelling about the number of insurance policies issued for the flight but none of them looks really phony."

He stood at the huge window of Senator Brogan's office, looking out at the shimmering sunlight on one of Washington's green malls. Over the treetops he could catch a glimpse of the Capitol dome.

Brogan sat comfortably in the big chair behind his desk. "But weren't there an unusually large number of policies issued?" he asked. His big hands toyed with a little silver airplane propeller, a souvenir of his long-standing interest in the problems of commercial aviation. "You know," he went on, leaning forward on his elbows and replacing the propeller neatly on the base of his fountain pen stand, "this is a matter of interest to me in more than an official sense. Eileen Bennett was one of my wife's best friends. She was on her way to Washington to visit us after a stopover in New York."

Kessler nodded. "I know that's one of the reasons you wanted to compare notes." He stood with his back to the window now, a stocky man with a jaw to match and short-cropped graying hair. "The newspapers were quite right, of course. There were an unusually large number of insurance policies issued for the flight but nearly all were for the minimum amount."

"What about Pearlow?"

Kessler frowned. "Pearlow had reason to be nervous. You know he survived a crash just three years ago. But anyway, the fact remains that we've looked into the backgrounds of every one of those people. None of them was facing any real financial difficulties!"

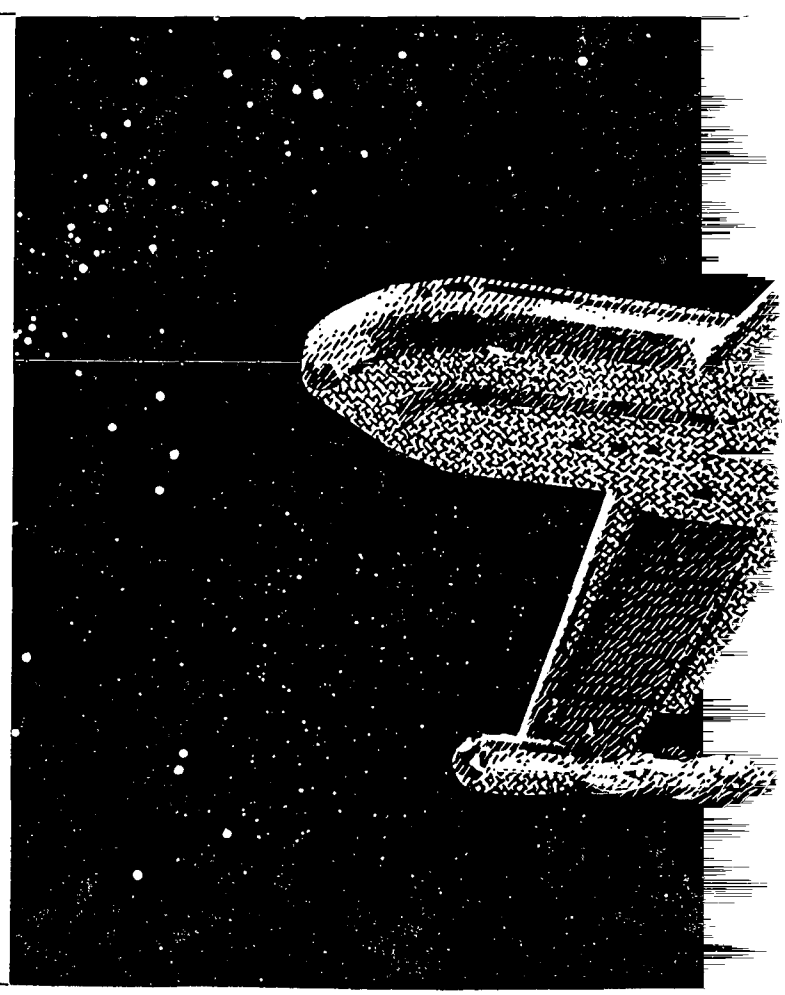
"That sounds odd in itself," George Brogan said, smiling slightly.

Kessler ran his hand over his hair and returned to sit in a leather chair beside the senator's desk. He smiled in response. "I know it sounds odd but it's true.

THE LAST STRAW

Some hypotheses are rational—
if not logical—but,
by their nature,
aren't exactly open
to controlled experiment!

by WILLIAM J. SMITH
ILLUSTRATED BY GEORGE SCHELLING



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Their troubles were all run-of-the-mill—getting taxes paid, the mortgage, a new car, a long-overdue raise in salary—that sort of thing. Nothing that anybody in his right mind would kill or commit suicide over."

Brogan lifted a bushy eyebrow in question. "Maybe you've put your finger on it there?"

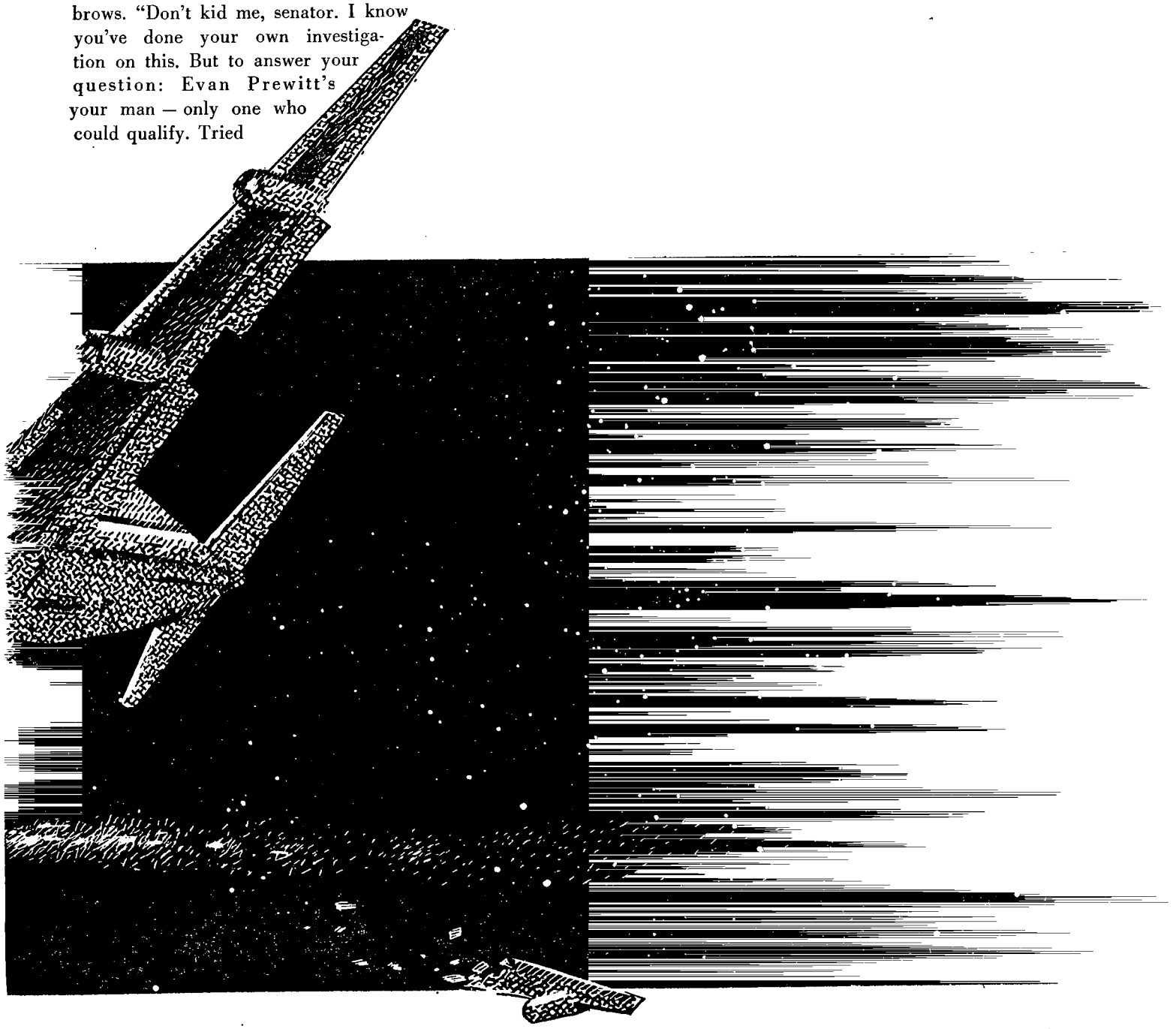
Kessler ticked off his reply, holding up one hand. "One former mental patient, pronounced cured ten years ago and apparently perfectly normal; a well-established businessman; a used-car dealer; three currently under psychoanalysis; a college girl twenty-one; a housewife with four children; an injured veteran just out of service. None showed any violent tendencies according to their doctors."

"Any criminals?"

Kessler regarded him wryly from beneath his eyebrows. "Don't kid me, senator. I know you've done your own investigation on this. But to answer your question: Evan Prewitt's your man — only one who could qualify. Tried on a manslaughter charge for killing his brother-in-law while they were out hunting. He said it was an accident and the jury agreed. He was acquitted. True, he had one of the large insurance policies, but then I'm sure you know Miss Bennett had one, too."

The senator nodded. "I knew that. But I know very little of Eileen's financial situation otherwise. Not," he added hastily, "that I would for a moment suspect Eileen Bennett of harming a fly. She's one person I could rule out. It would be just like her to fall down the steps getting off the plane, but as for her planning her own death or anyone else's, that's out of the question. She was much too scatterbrained. I hope that's not speaking ill of the dead."

Kessler frowned. "You'll forgive me, senator, in that



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regard, if I ask you a question? Miss Bennett didn't drink, did she?"

"Eileen? Heavens, no! Oh, she'd have a drink to be sociable, but it was usually a sherry and half the time she wouldn't finish that. I don't suppose you were envisaging the possibility that she highjacked the plane from four officers and two stewardesses and then wrecked it?" This time he smiled the broad toothy smile that made him a favorite with Washington news photographers.

"Hardly. The thing is, I've gotten so I feel I knew every one of those seventy-three people personally. You know, I've interviewed almost two thousand friends and acquaintances of those people and I'm not quite finished yet, just hoping I'll run across something that makes sense. I could have told you Miss Bennett's habits with a glass of sherry, that's why I was a little surprised."

Senator Brogan shook his head. "Oh, no, I didn't mean to suggest anything like that. It's just that Eileen was . . . well, clumsy is an unkind word . . . uncoordinated I guess, though she tried to make a joke of it. She was always bumping into things, spilling her glass of water and things like that, but not because she had been drinking too much."

"As for drinking," Kessler said, "there were quite a few real guzzlers on the plane. I don't mean that actor, who was notorious. He'd just lost a part because of his drinking and he was sober for a change. But it's amazing what you'll turn up about respectable people when you start investigating."

"I'm very interested in that aspect, as you may know," Brogan said. "We periodically get bills which would outlaw drinking aboard planes. What are your ideas on that subject?"

"Well, I don't mind a drink aboard a plane myself. Helps me relax. But I have seen some pretty unpleasant things develop during a flight when you get a nasty drunk riled up."

"Did you find any suggestion of that?"

"Not really. The plane took off from Chicago just after lunch time and a good many of the people who got on there had had a drink or two, but there wasn't really enough time to make trouble. The plane had hardly cleared the runway. All the passengers, except one, had their seat belts fastened."

"Now there is something I didn't know! Who was this?"

"Preston, a lawyer from New Jersey. You know how tentative any reconstruction of events must be under the circumstances, but we're pretty sure of this, especially since there was no fire. Preston apparently broke a fingernail trying to fasten his seat belt and one of the stewardesses had brought him a little first-aid kit. He had torn open a Band-Aid and was trying to fasten it around his finger. Obviously this was just before the crash."

"But how do you know he did it with the seat belt?"

"Guesswork, except that it wasn't fastened and we think maybe it just got overlooked after he hurt himself."

"Was he one of the drinkers?"

"No, not at all. Never touched it. In point of fact, nobody was really drunk at the time of the take-off. The flight engineer however had had two drinks at lunch."

Brogan raised his eyebrows. "You *were* thorough. You're sure?"

Kessler nodded. "Brown was a problem drinker though it didn't seem to interfere with his work. The two drinks are all he had that day so far as we can determine. He showed up for lunch at a girl friend's apartment with a black eye. Made some joke about walking into a door and wouldn't tell her anything else about it. She gave him the drinks at his request, and a big lunch, and put a little makeup on his eye because he'd been pulled from a flight a few months before when he showed up looking as though he'd been in a scrap."

"How did he really get the black eye?"

"There you've got me. Maybe he was telling his girl friend the truth. He had an estranged wife, incidentally, but she hadn't seen him for years. Good riddance, she said."

Senator Brogan picked up the propeller again and rolled it reflectively between his palms. He looked intently at Kessler. "Nothing seems really conclusive, does it? You know some of the wild rumors that have been going around about this crash?" Kessler nodded and started to speak. Brogan held up his hand. "Let me finish. You know and I know—or at least we think we do—that there's nothing to most of these rumors. And I'm not even talking about the wilder ones, like the little people from outer space who are knocking our airplanes down without leaving a trace. You get three or four of these unexplainable accidents and somebody is sure to come up with a really crackpot idea. The general public will not be convinced that this sort of thing *can* happen with no discoverable reason. Usually we have no way of reconstructing what happened before the accident. Just a couple of unintelligible remarks on the radio, as there were here, and then everyone is dead, the plane is totally demolished, and witnesses on the ground come up with ten different hysterical accounts—if there are any witnesses at all!"

"But this was a little different, after all, senator," Kessler interjected.

Brogan held up his hand again. "Just let me have my say. You know we folks down here in Washington always have a lot to say and we hate being interrupted." He smiled briefly. "This sort of thing has been going on in aviation history for the last fifty years—these unexplained accidents—and there's nothing especially new about this last one. You're shaking your head, but

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let me continue. One of the reasons they are now getting so much attention is that with the big jets the loss of life is apt to be pretty appalling when an accident does happen, but the actual number of accidents per flight—as you well know—is far fewer than it used to be and has been going down steadily over the years."

Kessler, slumped deep in his chair, fingers arced together before him, stared morosely but said nothing. "Secondly," Brogan went on, "it is not true that these accidents are happening more to American planes than foreign ones. Again it is chiefly that we are scheduling more and more flights. On the law of averages we are doing very well. You know how many crashes the foreign carriers have chalked up in the last year. And just about the same proportion are these so-called unexplainable crashes. It's not that they are unexplainable! It's simply that we don't have the information that would explain them! The very circumstances preclude that Am I making any sense?"

Kessler nodded. "Yes, senator, I suppose you are, but it doesn't make me any happier. I want to find out why and stop them."

"So do I, I assure you. But let me finish briefly. Among the other wild rumors are suggestions that we are being sabotaged by foreign agents or by their tools. Well now, I'd be the last one in the world—you know my record—to deny the possibility of some folks doing this if they thought they could get away with it. If I thought for one moment—or if I thought that you thought for one moment—that there was some international sabotage going on here, I'd say go on with your investigation till you get the answer!"

Brogan flung himself back dramatically in his big chair, throwing out his arms. "Meanwhile, what are you accomplishing? You've spent—and I happen to know this for a fact—almost a million dollars on this investigation. By your own account you have personally talked to two thousand people about it! You have kept this accident in the public eye and given it far greater importance than it deserves—through no malicious fault of your own, to be sure! But what have you got? Nothing. Exactly what I came up with. Nothing. Tell me, for example, where you got with the political possibilities of this thing. I know you didn't overlook it!"

Kessler smiled wearily. "Just about everything you say is true, George. Only, you see, I would probably never have ended up running this investigation if I were the sort of person that comes up with a question mark for an answer. I said 'human error' in my report, but that doesn't satisfy me. I want to know what human error. I don't think anything happens without a reason. Somehow I feel that it's all there, the answer, in those couple of million details we've pieced together about the plane and the crew and the passengers and it's staring me in the face if I could only see it."

"I agree with you." Brogan raised his hand again in his imperious gesture then dropped it to the desk. "No. I asked to have my say. Now you have yours." He sat patiently.

Kessler grinned. "Thanks, senator. As for the political sabotage possibilities, you've undoubtedly seen a copy of my confidential report. Three of the passengers had definite subversive connections in the past. I know, I'm not trying to make much of this. Their associations all date back to the 1930s and one of them was just a girl flirting with a Communist fellow student, but we didn't want to overlook any possibilities. Pearlow, on the other hand, was Russian born. He's the one who barely survived another airline crash three years ago."

"Pearlow was perfectly loyal. Just an ironic coincidence, that's all. I know the papers tried to make something out of it but I find it hard to believe that you took it seriously. As for Stepowski, he testified openly about his past here in Washington five years ago."

"I know. I even know that Stepowski's favorite television program was 'I Led Three Lives.' I tell you there's very little I don't know about anybody who was aboard, with one possible exception."

Brogan was alert. "Who's this?"

"Oh, it's no great mystery, senator. Robert J. Spencer, of Keokuk, Iowa. We know quite a bit about him, actually, but it's all third hand. He was a retired court stenographer, seventy-three years old, going to New York for his sister's funeral at the time of the crash. He boarded the plane at Chicago. He took a train to Chicago because he didn't like to fly, then he got sick there, apparently from some mushrooms he picked at home and had for lunch before he left. He had to lay over in Chicago for a day and then he got on the plane at the last minute so he wouldn't miss the funeral."

"Sounds to me as though you knew everything about him."

"Funny thing, though," said Kessler, "I have yet to speak to a single person who ever exchanged ten words with Robert J. Spencer. He lived alone, a complete recluse. Neighbors never saw him. Probably his sister would have been able to tell me something about him but she's dead. Actually, while I'm here in Washington I'm going to stop by and see an old acquaintance of his, a Miss Valeria Schmitt. They worked together as court stenographers in Iowa City more than twenty-five years ago. They were engaged but they never married. She moved here during World War II and they never saw much of each other after that." He shrugged. "I know it's a long shot, but I don't want to miss a chance."

Senator Brogan shook his head, smiling. "I have to admire you, Kessler. But may I express some little reservation? Do you really think looking up an acquaintance of Mr. Spencer's from twenty-five years ago is going to help materially in solving the mystery of a plane crash that occurred just last February? Or that the taxpayers could be very happy at this sort of expenditure of their money?"

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Kessler flushed darkly and leaned forward in his chair, clasping his hands. "Senator," he said, his voice cracking a little, "the taxpayers are not spending a cent currently on this investigation. My staff has been dismissed or returned to their regular duties. I went off the payroll three weeks ago. My final report has been submitted. I'm doing this at my own expense because I feel that I have to. I'm not satisfied. There has to be an answer!"

Brogan turned the emotion away from himself with professional skill. "Bob, look," he said, addressing Kessler by his given name for the first time during their interview, "I'm not criticizing you personally for a second. And that's not why I asked you to stop by. I asked you to come over and see me as a favor. You're not working for me and I don't pretend to be in any position of authority as far as your investigation goes. I asked you here because I'm deeply concerned myself about these accidents and I wanted to know if you could enlighten me in any way. May I say one personal thing though? Aren't you getting emotionally involved in this?"

"Of course I'm emotionally involved!" Kessler burst out. "I'm sorry, George." He passed his hand over his face and went on in a lower voice. "It's just that I've been eating, breathing, sleeping, dreaming this thing for the last six months. I feel as though I knew everyone of those seventy-three people personally. The Patterson girl, who looked as though she might be going to have a little good luck for a change. I even know that the pilot nicked himself shaving that morning. His friends called him Mike even though his name was Edward. He had a fight with his wife the night before. She wanted to eat out and he wanted to stay home. He was working with this crew for the first time though they all knew each other very well."

"Really?" Brogan perked up. "I suppose I knew that. Is it possibly significant?"

"Possibly, possibly. Everything is possibly significant but nothing really adds up. The routines were all standard, the four men were all vets. Aside from the pilot they had all worked together for years, off and on."

"Still, couldn't wires have gotten crossed as a result of some misunderstanding with a new pilot aboard?"

"Sure they could. What with the flight engineer being a souse and the pilot new to the crew and the co-pilot just back after a two-month layoff because of a ski accident. 'Human error,' that's what I said."

"Ski accident? I thought it was the stewardess that had the ski accident? I'm not going to trip you up in your own bailiwick now, am I?"

"Stewardess?" Kessler frowned. "You must be mistaken, senator."

"I felt quite sure," Brogan said musingly.

"I know your reputation for a fact, senator," Kessler said uncomfortably, "but a stewardess with a ski accident. Oh! Oh, yes. But not recent. That was Miss Sosnak, but it was almost a year before. The newspaper accounts got garbled. Both she and the other stewardess, Miss Prentiss, were ski enthusiasts. They were thinking about spending the weekend at Stowe after they got to New York, even though they had both broken ankles previously. Their friends in San Francisco were joking with them about it before they left. They gave Miss Sosnak a doll with a cast on its leg as a gag. The doll was found in the wreckage. Apparently Miss Sosnak had given it to the little girl who was killed on the flight, Barbara Patterson, who actually had a cast on her leg at the time. She had fallen and hurt herself a few days before."

A buzzer on Senator Brogan's desk hummed two short discreet hums. Brogan made no attempt to answer it. He stood and came around the desk, putting his hand on Kessler's shoulder. "Don't get up just yet," he said. "My secretary buzzes me every fifteen minutes in case I want to show my constituents how busy I am. If there's anyone waiting, let them wait. There's just a little bit more I'd like to say." He sat in the wide embrasure of the window and leaned forward on a crossed knee. He looked the picture of negligence but he was obviously pausing to choose his words with care. Kessler shifted his chair to face him.

"I won't mince words," Brogan said, "because I think we understand each other. We always have. Thanks to your splendid investigation, and my only little efforts perhaps, we know more about the circumstances of this crash than any other in aviation history. I had exactly your feeling that the answer ought to be there. But I don't see it and you don't see it. We know absolutely everything but one thing. We don't know what caused it. And we're never going to know that. I really think you are doing the aviation industry, yes and the country itself, a real injury by going on. I won't say what I think you're doing to yourself because it will sound like a sentimental appeal and you've known me too long not to know I'm pretty hard-headed."

"The investigation is over," Kessler said sullenly.

"Yes, I know, officially, but you've just told me you're going on with it personally."

"It's one last remote chance."

"Well, tell me this, Bob, if this last remote chance doesn't work out, will you call it quits and not start in on another last remote chance? Will you and Margaret get on up to that place of yours in Maine and take a good long vacation?"

Kessler smiled wryly. "Margaret has ideas of her own along that line. She's followed through on this with me all the way but she came down to Washington to meet me today and she says she's going to drag me off when I'm through here."

Brogan smiled his famous smile. "Good girl, Margaret. If she's here and has a leash on you, I know I don't

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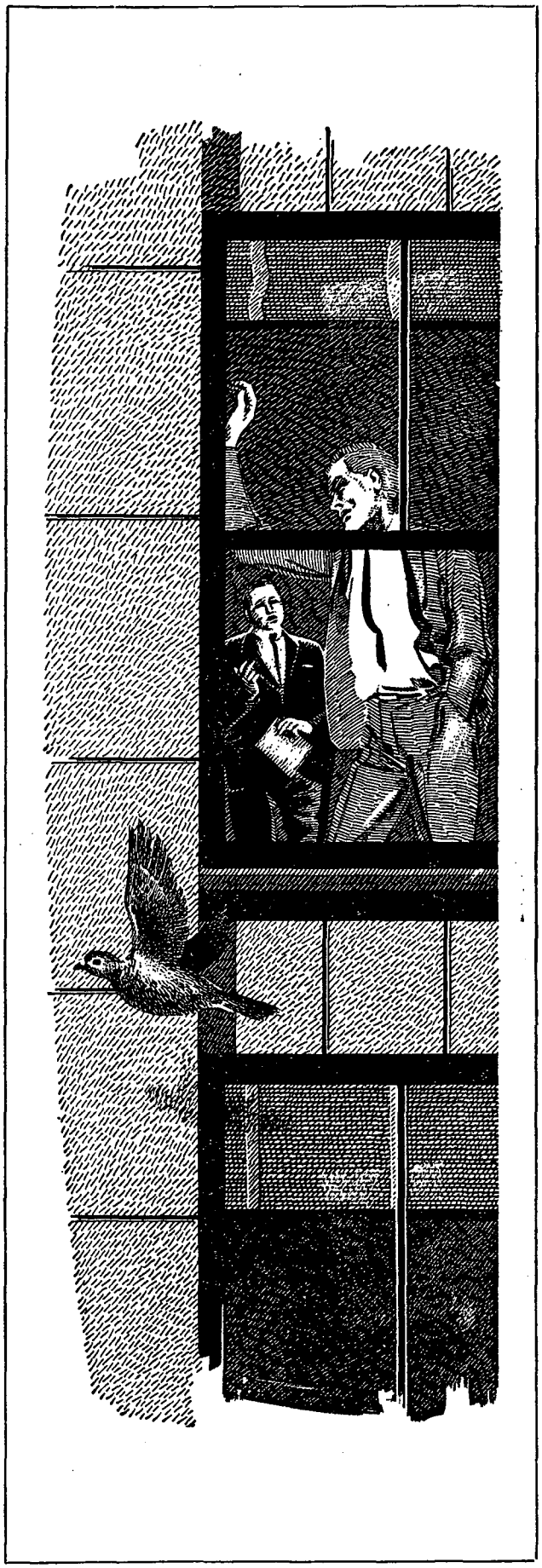

have anything to worry about. There's nothing I admire more than a woman who has a mind and uses it. I'll tell you something else," he said, standing and permitting Kessler to rise this time. "I was truly sorry about Eileen Bennett's death on this plane, but Eileen was getting along like me. Sarah Pollitt's was the really tragic case, to have accomplished so much so young and with that fearful handicap! From childhood, too, wasn't it?"

"Actually, she was about seventeen. Someone threw a firecracker in a car in which she was riding, but she could see partially with one eye."

Brogan nodded. "But a beautiful woman, for all that. And then to have achieved so much. I understand nothing about chemistry but I know her international repute. She had just become head of the chemistry department at Wellesley, hadn't she?"

"Radcliffe."

Brogan laughed loudly. "I might have known I couldn't trip you up. But tell me this," he added slyly, "did you know that Dr. Pollitt had once been a good friend of Bergmann?"

"Our former Commie on the plane? Yes, as a matter of fact, we came across that quite accidentally. You did a good job, senator."

"Well, you know we have some sources not generally accessible."

"Then you undoubtedly found out that though Sarah Pollitt and friend Bergmann knew each other well at one time she dropped him like a hot cake when he suggested she do a little undercover work for the Commies. Their being on the same plane was the sheerest coincidence."

Brogan stood with his hand on the door which led to the corridor. He nodded. "That was a little hard to take, wasn't it? We really thought we had something there for a while." He sighed. "It's like the whole thing, Bob, irrational and unexplainable. And believe me, I hope I haven't sounded critical of the job you did. I hope we can call on you whenever we need really expert advice?"

"Of course, senator, though I don't feel much like an expert on anything right now."

"You did your best, Bob." He patted him on the shoulder in farewell.

Kessler walked down a long marble corridor to a rotunda. His wife waved to him from across a staircase. She looked pert and cool and girlish in her ice-blue suit and perky hat. "Here, darling! Oh, you look so discouraged! Did George give you a hard time? He can be a brute when he wants to."

"Not really. He thinks I ought to call it quits."

"And don't you think so, dear?" she asked, taking his arm as they started down the stairs.

"Who me?" He grinned with sudden boyishness. "You know me. Never say die! If I thought we ought to give it up would I be trying to find this old bag

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Valeria Schmitt or whatever her name is? Brogan was right, that's just about as farfetched a notion as has come down the pike in a long time."

"Well, it may be farfetched, but she's not an old bag. I called her to make sure she'd be at home. I didn't know how long you'd take in there. She was very excited that you were coming to see her."

"Did she know who I was?"

"Of course, even aside from the letters. She's been following the investigation very carefully. She didn't seem to think it was at all curious that you wanted to see her because she knew someone twenty-five years ago."

Kessler laughed as they stepped out into the hot sunlight. "Well, if she's not a bag she's a bat. The more I think about it the crazier it seems. Suppose we get it over with now and start for Maine tonight. We'll be all set to go."

"Good! Good! That's the way I like to hear you talk. We'll make it a second honeymoon."

Margaret was still musing dreamily when they finally got to the car and started off in the direction of Silver Spring, where Valeria Schmitt lived in maiden retirement. "It will be just wonderful, dear," she said and then sighed. "Oh, but it reminds me of those poor Valentes, going off on their honeymoon."

"Now, now. I'm the one who's supposed to be obsessed with the crash, not you."

"Oh, but that was so sad. He was so handsome. And she was a pretty little thing, too, if you could tell from the wedding pictures. And then having postponed the wedding twice, too! It seems just like some fate was dogging them."

Kessler chuckled. "I don't think mumps really qualifies as an evil fate.

"No, but can you imagine! First him and then her! If it had been only one or the other they would both be alive and happy today."

"Alive anyway. I talked to some of his friends who suggested he was a mean one even before he had mumps." He smiled at his wife. "Even if he was good-looking. And now will you look out for Miss Schmitt's number before I pile us up and we miss out on our second honeymoon?"

Miss Schmitt proved to look as well as sound much younger than Kessler knew her to be, a bright and plump little woman with very very blond hair tightly curled. Margaret had come along into her little apartment without much urging. Miss Schmitt had apparently been expecting both of them because she had three flower-painted glasses out for lemonade.

"I suppose I'm old-fashioned," she was saying cheerfully before they were even settled, "but I don't hold by cocktails. Nothing more cooling than good old lemonade. Real lemons, too, not this bottled stuff. You know what they say—you can take them out of the country but you can't take the country out of them!" She laughed breathlessly. "I've been living in the big city for twenty-five years now but I'm still an Ioway girl. Get back almost every year, too, still perfectly at home there. I'll be sitting out on the veranda next month drinking lemonade and shooing flies like I'd never been away!" She laughed her breathless laugh again.

Margaret was obviously enjoying herself as much as Valeria Schmitt. Even Kessler was relaxed now, leaning back in the choice chair by the window with his collar pulled open. His search *had* been a neurotic one, he decided, as he listened to Miss Schmitt's pleasant chatter. He realized he would learn nothing here, but now he was not angry even with himself.

Miss Schmitt had taken the first opportunity to explain that she was a lot younger than her old boy friend, who had died in the crash at the age of seventy-three. "Of course my family were against Bob Spencer for that reason, too. He was almost fifteen years older than me." Kessler suppressed a smile. He knew the difference in age was more like ten years, but Miss Schmitt was secure in her blond, plump good cheer. "It's a little too much," she went on, "fifteen years, but then we never really did hit it off. Never really broke off, either." She held up her hand, displaying a ring. "See. Just got it out a few months ago. Haven't worn it for I don't know how many years. When I left Iowa City—"

"I thought it was Keokuk?" Margaret interrupted. She was perfectly at home with Valeria as she sipped her lemonade.

"No, honey." It was girl-talk now and Kessler was happy to let it go on, feeling suddenly very tired. "We worked together as stenographers in Iowa City. I was from right near there, but Bob was from Keokuk. That's where he retired to. Anyway I got this job in Washington during the war—World War II, that is—and I went back pretty often and saw Bob but I was young and foolish at the time and kept putting off and putting off the wedding and then it just never did happen. I offered Bob his ring back but he wouldn't hear of it. Said maybe it would still work out for us. Course by this time I knew it never would."

"Oh, I'm so sorry." Kessler caught the note of real sincerity in Margaret's voice. "That seems too bad."

"Oh, why be sorry?" Valerie asked gaily. "I'm not. Bob was real sweet in his way but he was a real stick-in-the-mud even when I first met him."

"I understand he was actually a recluse in his later years," Kessler said.

"Later years! Lord, he was a recluse when he was thirty-five. Worried about everything. I never regret it. My friends used to say I was snapping him out of it but I could never see much sign of it. Wore gloves all the time to protect his hands and so he wouldn't get any germs. It must have been the lemonade I was making a

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little while ago, Mrs. Kessler, when you called, reminded me of one time when he was visiting me back in Iowa. Just like I said, we were sitting on the veranda drinking lemonade I do believe and swatting flies and Bob was laughing and talking along with everyone else. Well, he was in a rocker just like this one and I gave him the fly swatter because he was laughing at me and I said, 'O.K., mister, you go ahead and try to hit one if you're so smart.' And he gave a great big swing, laughing, and that rocker went right over the edge of the veranda!" She laughed her breathless laugh till she had to dab at her eyes.

Kessler and Margaret smiled at her innocent memories. Kessler suppressed a yawn. "Oh, my," Margaret said, "the poor man! How embarrassing if he was that shy."

Miss Schmitt examined her lacy handkerchief in sadly smiling recollection. "I shouldn't laugh now," she said, "but it was so funny. He didn't think so, of course! He stomped right out of the yard without a word. I wouldn't have thought it was funny then if I'd known how bad he hurt himself. He was laid up for about three weeks. I guess that was the beginning of the end for us. Bob said every time he went out something terrible happened to him. Poor fellow. He was right at that. Just a bad luck artist."

Miss Schmitt was prepared to reminisce indefinitely. Kessler decided he had better come to the point. "I don't suppose, Miss Schmitt," he asked, "that you and Mr. Spencer ever discussed politics?"

She shrugged. "Why, yes, I guess we did a little, being among politicians in court and all. We were both good solid Republicans though, so we didn't have much to say back in those days. I voted for Roosevelt in 1940 but Bob didn't mind."

"This may sound farfetched, Miss Schmitt, but to your knowledge was Mr. Spencer ever interested in Communism?"

"Bob?" she asked incredulously. "Bob interested in Communism? We didn't even know what Communism was out there. Never! You can count that out, mister."

"I'm sure we can," Kessler said. "Did he drink?"

"Not a drop! I wouldn't have put up with that myself."

"Would you ever have thought he was suicidally inclined?"

She thought about this one. "You mean he might have put a bomb on the plane? Like that fellow did a few years ago?" She shook her head slowly. "I can't believe Bob would kill anybody else just to kill himself. What would be the point?"

"Exactly. He left no one behind him. Didn't even take out an insurance policy. But, of course, people sometimes do crazy things."

Miss Schmitt's plump little face was silent and reflective. "Bob was an odd one. And, of course, I haven't seen him for years but I got a Christmas card and a little note every single year and he always seemed perfectly sane to me. As for killing himself or anybody else, I'd say he was much too timid a man for that. God forgive me if I'm being cruel to an old friend who's gone now, but he was afraid to step outside the house. I don't know how he got to work. He was always getting sick or getting hurt and staying home for weeks. I think he welcomed sickness just so he could hide at home safe." There were tears of another sort in Miss Schmitt's eyes now. Kessler thought he detected a brightness in his wife's eyes. "No," Miss Schmitt said, "Bob was afraid of life. Just plumb scared." She refused to let the tears flow. "Oh, but I'm being a terrible hostess! I have so few visitors now. How about some more lemonade?"

Margaret flicked a glance at her husband and gave him the floor. "You've been a wonderful hostess," Kessler said, rising, "and I want to thank you for being good enough to talk to us."

"Well, I'm afraid I haven't been much help," she said, rising to flutter over the glasses.

"That's not your fault," Kessler said. "As you know, we haven't come up with an answer on this investigation, but at least they can't say I didn't try."

Miss Schmitt waved to them from the window of her apartment as they got in their car. "She was sweet, you know," Margaret murmured as she waved back gaily. "Sad about them, too."

"Well, investigation's over," Kessler smiled at Margaret as he drove away. "Results, nil. Second honeymoon, anyone? We've got nothing to keep us now. How do we get to the highway from here?"

"Yes, dear," Margaret murmured, still bemused by Miss Schmitt. "But wasn't it a shame they never got married? He was such an unhappy man. She might have brought him out of it."

"I doubt that," Kessler said, adjusting the sun blind against the evening glare of the sun.

"Like she said, he was a hard luck artist. It's a personality type, it doesn't change."

"What?" Kessler asked, maneuvering a corner in heavy traffic.

"Accident prone. You know, everything happened to him. Like those mushrooms he got sick on just before he left home; falling off the porch. No wonder he didn't want to leave home."

They drove in silence for some time, Kessler intent on the evening flood of traffic, Margaret almost drowsing in the evening sunlight and the cool of the breeze in her hair. When Kessler pulled up at a drug store she said, "What?" sleepily.

"Phone call I have to make. You wait here," he said. She nodded.

Kessler got through to Senator Brogan's office quickly. "Hello, Miss Persons? I'm glad you're still

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there. This is Bob Kessler. Do you have any idea where the senator is now? Good, would you put me through to him?"

Brogan sounded anything but sleepy. "Yes Bob? Finally wind it up?"

"I think maybe I have," Kessler said. "I've seen Miss Schmitt."

"Ah, Spencer's old flame? And what did you learn?"

When Kessler was finished telling him there was a long pause. "Are you still there, George?" he asked.

Brogan's voice was heavy. "Yes, Bob, I'm still here. Where are you calling from? A public phone? Well, I think maybe you'd better come up here. We have more to say than you have dimes and it won't hurt to keep this to ourselves if we can—or till we're sure. Better bring your complete files. Good. One point, though! Did anything I said this afternoon help? I wondered. I couldn't really believe it myself. If you'd said something, I wouldn't have felt I was going crazy. I've been sitting here wondering if I should see a head doctor."

Margaret smiled philosophically when Kessler told her he had to go back to see Brogan. "Some second honeymoon," she complained. "Well, anyway, what about that drink and a steak dinner. I'll get us a hotel room. Maybe tomorrow, like I always say."

It was nearly ten o'clock when Kessler and Brogan met Margaret at the hotel dining room. "It's about time!" she declared. "I'm starving. Hello there, George. What are you doing to my husband? Or vice versa? We were going to go on a second honeymoon and now he has that fiend-for-work look in his eye!"

"My dear Margaret," Brogan said, holding her hand and smiling gallantly, "I must deeply apologize for keeping Bob. And I'm almost frightened to say that it looks as though it will be for some time longer. We will have to go back after dinner and it may be some days before either of us has much free time."

Margaret looked at them suspiciously, with the brightness in her eye that came from her first martini. "What are you two up to now? Some of this top secret stuff? I might know! I can't get away from it! Never mind, I'll worm it out of Bob when I get him alone. If that ever happens!"

They carefully avoided any further reference to the investigation until they were halfway through dinner in the nearly deserted dining room. Margaret, mellowed by a second martini and all of her steak which she ate, sighed. "Poor Miss Schmitt," she said. "I've been feeling sorry for her all evening when I haven't been feeling sorry for myself."

"Why Miss Schmitt?" Kessler asked, chewing.

"Oh, I shouldn't, I know. Bob Spencer would probably have been a worse husband than you are. But at least I'm glad I went along with you to visit her. I settled something that's been bothering me."

"What was that, dear?" Kessler asked, raising a juicy morsel of steak to his lips.

"Why, that he was accident prone."

Kessler lowered his fork. "Yes, you mentioned that before," he said carefully. "I was telling George about it. But why did you think he might be?"

Margaret looked at their startled faces. She fluttered her hands. "Well, everyone else on the plane was."

The three of them stared at each other. "Did I say something wrong?" she asked nervously. "Well, they were, you know! The stewardesses both had broken their legs. And the flight engineer got a black eye walking into a door. You remember, Bob, you couldn't be sure how it happened, but that must have been it. Even the pilot had cut himself shaving. That very morning!"

Kessler and Brogan had stopped eating and were watching her intently. "Stop staring," she said indignantly. "You're making me nervous. What's wrong?"

"Nothing, dear," Kessler said quietly. "It's very interesting. Go on."

She looked at him suspiciously. "Well, when it comes to the passengers! What do you mean? You know all this!"

"Go on," Brogan said.

"Well, one man was even in another plane crash before. I forget his name."

"Pearlow," Kessler murmured.

"Pearlow, yes. And Dr. Pollitt who was blinded in an accident. I don't really know about your friend Miss Bennett, senator."

Brogan nodded. "She qualifies."

"And the little girl, Barbara? Who had the automobile accident? The veteran? Prewitt, who accidentally killed his brother? At least two of those people were going to psychiatrists. Well, Mr. Spencer had me worried because I didn't know if the mushrooms qualified him as accident prone. Then, of course, when I found out about him definitely I figured the Valentes qualified, too, with the mumps. The man who broke his fingernail! Oh, just about everybody I think.'"

Kessler and Brogan glanced at each other. Brogan nodded. "Just about everybody," he said. "And all on the same plane. It's something that would happen once in ten thousand times. Like being dealt a solid suit in bridge. But it can happen. It seems to have happened this time. And I think maybe it's happened before. Maybe one person who was not accident prone could make the difference. But when I think about a plane taking off with those particular seventy-three people aboard it really scares me."

Margaret looked from Brogan to Kessler, confused. Kessler put his hand over hers on the table cloth and gripped it tightly. "Darling," he said, "when we have finished our coffee, George and I are going back to his office and I think maybe you'd better come along with us. We have a lot of thinking to do, the three of us, and we could use a feminine touch." ■

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CHRONO-CONTROL

Just because you want something most desperately doesn't mean you'll be happy if you get it . . .

FRANK A. JAVOR
ILLUSTRATED BY GEORGE SCHELLING

The chrono-control set into the circling, air-cushioned bulkhead of Alfy's prison space capsule didn't look much like a conventional keeper of time, but it did its job well enough and Alfy hated it with every gravity-responding ounce of his scrawny, near-naked body. Hated it with a hate that was not a surging, flooding burst of emotion—Alfy was long past that stage—but a burning, devouring, ranking glow.

Washed in the dim red light coming from the night-set panels overhead, and wearing only the short, unbelted gray kilt allowed him by the regulations governing maximum-security prisoners in solitary orbit, Alfy sat on the edge of the fold-down shelf that was his bunk during the hours allotted him for sleep by the timer-controlled devices of his escape-proof satellite prison and glared at the ring-shaped object of his ire.

Installed in the curving wall at the head of his bunk so that, sitting, he had to twist his head to one side to see it, the chrono-control looked to be a single loop of flattened metal rod a scant four inches across. Although hard to make out in the dim red glow, Alfy knew that it was silver in color. In spite of the fact that there was no real night and day out here where he was in orbit, the standard twenty-four-hour markings of the normal Earth day were etched along its perimeter—twelve in the sector blackened by a dip in some darkening solution, twelve in the half-circle left metal-bright.

Safe behind the small, quiltlike bulges of the capsule's clear plastic cushioning, the timer-control was a self-contained unit. It was free of any physical connections to the relays and devices behind the wall and under the floor and above the ceiling of the seven-foot high, nine-foot across cylindrical cubicle that was Alfy's cell and the hollow core of the prison satellite that it controlled.

Ringing the small cross-section of the circled rod, and seeming to come from deep inside the molecular structure of the metal itself, was a razor-narrow but unmistakable band of deep blue light. It looked to be standing still, but Alfy knew that it moved. Slowly, imperceptibly, as the hour hand of a clock moves, Alfy knew that so moved the thin blue band of light, and for this moving and for what it would bring at any moment Alfy hated the chrono-control. Hated it and sat on the edge of his bunk waiting, his eyes bulging, never once moving from the thin blue line of light . . . waiting . . .

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Dim now, the blue light would at any moment spread to the 05:30 in the morning mark and pulse action into sudden brightness, and pulsing, would send its signal to start another day of Alfy's sentence at hard labor.

For this, Alfy was waiting . . . waiting . . .

The light pulsed! Bright! Alfy's hands, without his control almost, clapped themselves over his ears, his teeth clenched, his whole body cringed. Overhead, relays clicked in response to the timer's signal. The ceiling-light panels switched from their "night" setting of dim red to bright, sunshine clear and a blast, a raucous blast of sound burst from the ceiling and beat down on Alfy's hunched body.

Ready as he was for it, it still shook him. Shook him from his insides out to his skin. A full twenty seconds it would last, a length of time carefully determined and set, Alfy knew, by deep-psych tests as necessary to bring his particular body-brain type out of the snoring, slothlike near-coma that was his normal sleep-pattern.

For even more than physical exertion, work, Alfy hated to be roused from sleep and even under the best of conditions had always come awake with a great sluggishness and an almost animal rage at his tormentor.

But threats and ravings had no effect on a diaphragm vibrating in a ceiling and so Alfy's nerves and brain, seeking to at least spare themselves the shock of being blasted out of unconsciousness, now brought him to full wakefulness long before the chrono-control was due to pulse its first pulse of the new day and set him on edge and waiting.

This gambit of his own body and mind only added to Alfy's seething fury at the thing that set off this crushing flood of sound; the chrono-control in the bulkhead at his elbow.

The horn-blast from the ceiling cut off abruptly and Alfy almost sagged off the edge of his bunk at the sudden release from the pressure of the sound and of his own frustration.

But only for the moment. Then, screaming, ranting, filling the cut-off cylinder that was his cell with the sounds of his pent-up rage, he lashed out at the timer with his fist.

Again and again he hit the chrono-control, but he could do neither it nor his hands any appreciable hurt because of the quiltlike cushioning that covered not only the timer unit but the whole of Alfy's cell. Walls, ceiling, floor, even the milk-can-shaped emergency survival pod secured to the floor beside his bunk—everything was thoroughly protected by the tough, resilient clear plastic air-cell bulges.

There was but a scant handful of these maximum-security prison capsules hung in stationary orbit between the Earth and the Moon, and for this the Prison Board was thankful. Its five members, being human, did not like to be reminded that there were men like Alfy, who not only resisted their experts' best efforts to rehabilitate them, but inflicted the additional injury of escaping from the Earthside prisons.

The prison satellites were the Board's answer to the escape problem at least. Expensive? Yes. But not unduly so even for an agency with notoriously limited funds once the dead weight of the capsule was lifted out beyond the initial grip of the Earth's gravity. But you had to make it a point to keep everything in the capsule, and more importantly, the material you needed continuously to maintain it, down to an absolute minimum of weight and make whatever you did hoist aloft do multiple duty wherever you could.

The capsule lining, however, was a plus factor. The padding of the cell did not mean to imply that the prisoner was insane—far from it. But to avoid the fixed schedule that would let a man of all-too-demonstrated ingenuity know when to expect a visit from his guards and perhaps wring some advantage from this knowledge, the capsules were tended in a computer-determined random pattern. And the scarcity of men outside the pure military who could make a mid-space rendezvous as a matter of routine being what it was, it could conceiveably be as long as eight months between individual inspections.

At any rate, the Board wanted no sharp corners or even hard surface against which a man might fall or even throw himself and be injured when alone.

But what made the air-cushioning a plus factor was the fact that it was called such merely by convention. Actually, its myriad quiltlike cells were filled not with air but with helium, and the lift this provided at launching more than made up for the weight of the plastic needed to contain the lighter-than-air gas.

Water for a possible eight-month period was no real problem since the redistillation units were solar-powered and part of the same system which provided the energy for the force field that enveloped the capsule and kept it from being pierced by small meteors and other bits of celestial debris.

Damage from larger meteors and other objects too big for the force field to deflect was provided against by the survival pod clipped to the floor beside the prisoner's bunk. All a man had to do if his capsule was badly damaged, the Board reasoned, was to leap feet first into the milkcan-shaped container, slam down the round hatch and spin home the inside locking wheel set in its center. The two latches nearest the hinge, bottoming in their sockets, would set off the ejection charges and the pod, and its cramped-in passenger, would be blown downward and clear of the capsule entirely. The same bottoming would activate the automatic beeper in the pod lid and it was then just a case of waiting until the satellite tender, alerted and homing in on the beeper signal, managed to find and scoop up the survival pod.

Two small tanks in the pod carried enough air to last its passenger twelve hours. More than enough, the Board figured, even if the tender should have a little trouble

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making contact with so small an object as a one-man survival pod.

This was all drawing-board theory, of course, since space being as empty as it was, and the prison capsules so few, no prisoner had ever had the need to use the pod provided for him. This last was a source of small comfort to Alfy. Long ago he had lost the battle to push into his unconscious the gnawing thought of just how much time the air escaping out of a hole made by an object big enough to plow through the capsule's force field in the first place, would give him to make it into his pod, especially if it caught him when he was asleep.

Food, fortunately, was no particular problem. Tables had been worked out for how much nourishment a man of a particular body type and weight would need, and the controlled conditions of life aboard a prison satellite just made it that much easier to figure. It was more or less simply a matter of deciding how close you wanted to cut it with the safety factor you were using in your calculations.

But breathable air was something else again. Even if it were possible to redesign a standard indefinite-demand unit to regenerate only enough oxygen to take care of the needs of one man, it would still bulk up too big to fit into any spacecraft smaller than an auxiliary tender at least. So that left you with no choice but to use the much more compact rechargeable cartridge system even though its efficiency was notoriously low and the units weighed like solid rock.

Still, if you stole a hair of weight here, and a hair of weight there from everything else you put into the capsule, and, in addition, took advantage of the fact that a man at rest needed less oxygen than a man at work to have your timer divert less of the capsule's air into the regenerating system during his sleep and rest periods, you just barely could squeeze aboard a system large enough to carry him over the eight-month-maximum period he might have to go in the rare event that it was that long a time before your computer sent you around to him again.

The atmospheric pressure of the capsule's air was, of course, independent of its oxygen content and needed no control other than a simple pressure-responding valve on the system's trim tanks to keep it at a pre-set constant.

The blue light in the chrono-control pulsed again and the howling, ranting Alfy staggered, his body suddenly grown heavier, betrayed once more by his rage at the timer into momentarily ignoring its visual signal.

His palms slapped flat against the wall and he leaned on them, arms stiff, his head down, hearing from beneath his feet the small clicks as the gravity coils under the floor, responding to the silent command of the chrono-control, went in their graduated steps from the rest period setting of .6 of normal to full Earth gravity.

A whir and a splashing hiss came from the bulkhead section opposite Alfy's bunk but he did not turn his head. For six minutes the vacuum-operated shaver projecting on its stubby hose from the wall beside the silvered mirror panel would be available to him. For the same six minutes sun-warmed water would stream in a slender column from the flat disk in the ceiling. Alfy could shave and shower if he chose.

That was as far as the Board could go. The early prison satellites had carried monitoring TV eyes to check their passenger's compliance with the details of prison life, but these were long abandoned and their small weight reassigned to more fruitful items. To a man who was in orbit because of his demonstrated ability to circumvent locks and procedures to begin with, it was no challenge at all to preserve that small sector of his privacy by simply plugging or smearing over the eye opening with whatever came to hand. The equipage of the capsules, being as sparse as it was, what came to hand had at times been earthily biological.

Alfy ignored the shaver and the shower. He pressed himself away from the wall and stood panting, glaring at the small circle of the chrono-control. "I'll get you," he said through his teeth. "I'll figure out a way and I'll get you."

He lashed out viciously at it with his heel, then dropped down onto the foot of his bunk, waiting for the bowl-shaped shelf to come sliding out of it with his breakfast of warm cereal and heavily fortified milk-fluid. He was thinking of the chrono-control behind him and of his long and futile attempts to destroy it so that it could give no signal to the horn in the ceiling, to the gravity coils under the floor, to the shelf that was his bunk. Destroy it at a precise moment when the proper systems of his capsule were operative. When the timer's cycle was going from his night-chow time into the recreation period. When the supper-shelf lever could be pressed for the day's only seconds, when the rec-drink tap would work, when the vid-screen show was available, when even the grav-coils went to .8 of normal for a buoyant good feeling.

But most of all, when the horn in the ceiling did not blast and Alfy could just lie on his bunk. It was all he could think about, the thought pressing itself on him no matter what else he tried to think. Destroy the control and he could sleep. Sleep when he wanted to, sleep as long as he wanted to. Sleep. Sleep undisturbed.

Alfy's breakfast came sliding out of its bulkhead slot and he ate the oatmeallike food with the only utensil he had. A plastic spoon, rigid enough to hold his food, much too soft to hold any kind of a cutting edge.

Alfy had trouble handling it and he swore aloud. Angry at the stubbiness of the handle, doubly angry because it had been broken off and abraded by his futile attempts to somehow pry off or even rub through the tough plastic shielding that protected the capsule's timer. Elsewhere the plastic liner could be rubbed through, but not in any of the strategic areas, and the memory of having tried and failed deepened Alfy's sense of frustration. Fuming, he ate.

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Against the ever-present whispering sound of the air circulating through its vents, there came a faintly louder hiss. The chrono-control, readying the atmosphere for Alfy to work in, enriching it with the extra oxygen he would need, had deflected the required additional air into the regenerating system. The hiss was the sound of air from the trim tanks being forced into the capsule's atmosphere as their valve responded to restore the momentary drop in pressure. A click and another, louder, immediately following, was the bleeder valve in the opposite bulkhead opening and closing, keeping the system in precise equilibrium with the mindless self-satisfaction of a well-fed cow.

Alfy rammed the last of his food into his mouth, dropped his stub of a spoon on his bunk and darted to shove a foot-high, scuffed gray plastic cylinder with a large round handle fitted to its top from the circle it was standing in across the floor to cover a similar circle marked close to the bulkhead opposite.

The chrono-control's blue light pulsed bright. The horn in the ceiling blipped. The circle under the cylinder lit up green and instantly flickered out.

At about the same moment Alfy's spoon clattered to the floor as his bunk-shelf snapped down against the bulkhead where it would stay until his first rest period some fifty minutes from now.

Alfy paid it no mind, but holding the cylinder handle, he howled his glee. He'd outfoxed the chrono-control this time. Guessed correctly which of the three circles in the floor it would light up first to start another day of his sentence at hard labor. Guessed correctly and managed to shove the work-cylinder into the neutralizing zone before the chrono-control could send the gravity coil in its base to its normal work setting of just under fifty pounds.

The timer pulsed again. The ceiling horn blipped. Another circle lit up and Alfy lifted his cylinder by its handle, carried it across his cell and set it down on the light. The light went out.

Another pulse . . . another blip . . . another carrying. Alfy worked methodically, not missing a blip, not ignoring a lighted circle, knowing from sad experience that there was no way to get out of doing his assigned work. Knowing that, if more than three of the timer's pulses were not neutralized, he could expect the weight he was lugging around to get progressively heavier in ten-pound steps until it tipped out at an even hundred. The horn in the ceiling to blast him with longer and longer and louder and louder torrents of sound.

The timer was relentless in its insistence that Alfy do his work and if he persisted in trying not to, as he had in his early days in the capsule, it would retaliate with shattering torrents of sound, three and a half hours of sleep at night and nothing from his rec-drink tap and food slot but water and a hard, rectangular biscuit once a day.

A pulse . . . a blip . . . a carrying . . .

The horn blasted for a full three seconds. Alfy went to his bunk, now rising up to a usable position from the wall. The first fifty minutes of Alfy's day at hard labor was over.

He waited for his bunk to swing all the way up and lock before he dropped down onto it. Ten minutes he had to rest. To rest and to glare at the chrono-timer.

The timer. That blasted timer. If he could only kill that timer.

Alfy sat and stared. The horn blipped and he went back to work.

Resting. Again and again. Running his hand over the plastic shield keeping the timer from him. The plastic, so yielding to his touch . . . so impregnable to anything he had to attack it with.

Work and rest. Work and rest. Sleep. Sleep and work again. And always the preoccupation with how to get at the timer. The chrono-control. Until . . .

Alfy leaned forward, his heart beginning to pound with excitement, his eye caught by one of the small quilt-like sections of the plastic cell liner he'd managed to rub through in his early attempts to get at the timer from the side. It was flatter than the others. Of course! It had to be. Whatever gas had been imprisoned inside it to make it bulge protectively had long ago leaked out through the hole he'd made. He pressed the timer shield, struck it with his fist. It, too, had a gas inside to make it bulge.

Alfy licked his lips, rubbed his suddenly sweating palms against his kilt. He had a force at hand to use against the timer. A tremendous force, if only he could use it without killing himself in the doing.

Alfy forced himself to sit quietly on his bunk, to lie down with his trembling fingers locked behind his head, to gradually stop the racing of his mind, to think along a specific line. He slept fitfully.

As always, Alfy worked out his plan completely in his head. Mentally exploring the ramifications inherent in his basic idea, thinking and discarding, discarding and thinking. Checking out what he could check out of the capsule's devices, always careful to leave no mark or other indication of what he had in mind for an unannounced jailer to interrupt and find.

He counted the number of pulses the timer gave each fifty-minute work-period again and again. Found that although each time it started with a different circle, the number of pulses was always the same. Endured the head-splitting blasts of the horn in the ceiling to recheck his memory of whether or not the weight of his work-cylinder really did go to zero during his rest periods even though he let it climb to maximum by not moving it to a neutralizing zone when one lit up. It did and Alfy took his one hard biscuit for supper that night with an angry grin at the chrono-control. Once his plan was in operation, his life depended upon his being right.

He checked what he could see of the capsule's vents and valves, went over the survival pod again and again. And then at long last they came. One official, one guard,

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both armed and wary, probing ahead of themselves with their cane-mounted ferret-eyes before they entered so that he could not surprise them, also two capsule technicians. The pilot, stayed with the tender locked alongside.

They recharged his oxygen cartridges and his pressure trim tanks, checked out his valve systems. They refilled his food hoppers, smiling when they saw that but one of the dry biscuits had been used. "Simmering down, eh, Alfy?" one said and they went on about their work. They checked out the survival pod and its radio. They even patched the one quilted area Alfy had damaged. They gave him a new kilt and finally, as they left, a new spoon. One with an unbroken handle, grinning when they took back his stumpy old one, but not asking what had happened to it.

Alfy forced himself to wait a full hour before he set to work.

Using his teeth to help, it did not take Alfy long to tear his kilt into strips and plait them together until he had some four feet of springy, resilient rope. Nor did it take him particularly long to work the stiffer, looped waistband of his kilt through the grid guarding the bleeder valve. The valve kept his atmospheric pressure in balance by letting any excess from his trim tanks escape outside. The grid slits were too narrow for the tip of his spoon to be anything more than a token help.

But it took two days of swearing and sweating and every free moment he could snatch from his labor times. He worked right through his sleep periods, working blind because he could not see into the valve mechanism itself to finally catch and secure his waistband loop over the valve lever arm at a point where, by pulling on it, he could relieve the pressure of the heavy spring holding it shut and so force open the valve. He listened a moment to the sudden whoosh of escaping air and the corresponding faint hiss, a moment later, of the trim tanks restoring the lost pressure.

Then, exhausted as much by his just success-crowned efforts as by trying to breathe adequately in the oxygen-stingy air the chrono-control allotted him, Alfy staggered to his bunk and dropped down onto it, panting.

He lay there in the dim red light, not sleeping, sweating even though the capsule's air was at its usual optimum-comfort temperature, bending the semi-rigid handle of his plastic spoon back and forth until it broke in two. Then he broke off the bowl section and put it on the floor.

He lay there, the breath whistling harshly in his nostrils, from time to time rolling the broken handle bits between his wet palms, waiting for the light to come on full.

It did, at long last, and with it the raucous horn blast, but Alfy was paying it no mind. He darted to his survival pod and lifted back its lid. Carefully he turned the center wheel and watched the locking lugs just inside the hatch rim move outward in their sockets. He placed one bit of broken spoon handle into each of the two bottom sockets

so that their lugs could not position all the way home. Could not enter their seat opening in the opposite wall.

He turned the wheel hard, leaned his weight on it, then backed it off and dug out the spoon stubs with his nails. He tried the wheel again. The stubs had sprung the lug mechanism so that now the two bottom lugs lagged behind the others in their movement outward, but not enough.

Alfy put the spoon handle bits back into the lug socket and leaned his weight on the wheel again. He did it again and again, once nearly losing his balance as his body grew unexpectedly heavier when the grav-coils under the floor went to daytime normal.

From over his head the ceiling horn, protesting Alfy's ignoring of his work-task, flung blast after blast of sound over him. At last the bottom lugs, the two lugs that, bottoming, would have set off the survival pod's ejection mechanism and activated its emergency beeper radio, did no more than barely touch the rims of their seats.

Alfy darted a glance at the chrono-control. He had some twenty minutes of his first work period still left. He needed no more than ten.

The inlet from the trim tanks was a simple round tube guarded by a small grill. Alfy quickly stuffed it shut with bits of cloth left from the rope he'd made of his kilt. It was not an airtight fit, and Alfy did not want it to be. He

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did not want to stop the air from the tanks, just slow it down. He picked up the bowl of his spoon from the floor where he'd put it, then went to his work cylinder and, breathing hard, cringing under the blaring sound of the horn, he shoved it over to where his kilt-rope hung from the bleeder vent, swearing at its now doubled heaviness, snarling at himself for not thinking to move it beforehand while its weight was still next to nothing.

He took one last look around, then stooping, he tied the dangling rope to the cylinder's handle.

He heaved the weight onto his knees and held it there against the wall while he looped the slack, springy rope back on itself and through in such a way that he needed to slip the bowl of his spoon through the emerging loop to keep the whole arrangement from unraveling.

He was careful to insert only the tip of his spoon, being doubly careful to stay well below the middle of its rim curve.

Alfy eased the weight down until the rope was taut. The bleeder valve began to hiss. Gingerly Alfy took his hands away altogether. The weight sagged a little more, the hiss became a low throaty roar as the rush of outgoing air increased, then stopped abruptly as the weight thudded against the floor. The supporting rope suddenly became lax as the spoon bowl, insecurely seated, slipped from its loop.

Alfy grinned nervously, shaking his head to clear his vision of the sweat running into his eyes and the almost physical impact of the horn blasts.

He lifted the weight again and repeated his looping process, delicately seating the spoon bowl a shade more firmly. And, when the escaping air was a steady roar again, he darted to his survival pod, doubled himself in, slapped its air supply valve to the On position, slammed down the hatch, and spun home the remaining operative locking lugs.

He was committed. There was nothing to do now but to sit in the absolute darkness, his knees cramped against his chest, and wait. Wait for the forces of nature to take their course. His life was on the line, but, if his planning was anywhere as good as he hoped it was, then the chrono-control was his.

Alfy waited. Waited, cramped and bent double, to nearly the full limit of his pod's air supply, then, dizzy and gasping, he spun open the lock wheel and flung back the lid.

Air and the red glow of the night lights, almost blinding to Alfy by his long hours of absolute blackness, poured in on him. Air. Breathable, oxygen-laden air filled the capsule and Alfy shouted his exultation.

He clambered out of his pod and tried to stand, but his legs, cramped bloodless, would not hold his weight and he sagged to the floor.

He sat there, helpless, laughing, shouting his glee, feeling the shreds of ruined plastic on the capsule floor. Looking around and seeing, even in the dim red light, that every single quiltlike bulge was gone from the plastic liner. Every little plastic pocket hung ripped apart, its wall ruptured when the gas it held confined at more than atmospheric pressure burst out into the vacuum Alfy's cell had become when the flow of air from the plugged trim tank inlet could not keep pace with the air rushing out of the open bleeder valve.

A bleeder valve held open by the weight of his work cylinder, a weight that, dropping to near zero at the rest period, had let the valve's own spring snap it shut. A weight that could not open the valve when it grew heavy again because the rope that held it was now too long to lift it clear of the floor. A rope whose shortening loop was lost when, slackening, its own springiness had spat out the curving slope of the spoon bowl that held it.

Now, air leaking even slowly from the trim tanks could, if given time, restore the pressure to normal. And he had obviously given it enough time.

When his legs would carry him again, Alfy staggered to the chrono-control and when he saw no hanging shreds, his heart stood momentarily still. Then he saw that the protective bulge was gone. Not torn asunder like the others, but simply popped out of its frame in one piece and lying on the floor. The timer was his.

He licked his suddenly dry lips and, trembling, wiped his hands on his naked sides before he reached in to touch it. It came out easily, being self-contained and not connected, its small circle merely snubbed in under a triangle of clips, its blue glow undisturbed.

In Alfy's hands it felt surprisingly light and even smaller than in its compartment in the bulkhead. Alfy held it a long time, savoring its helplessness, before he slipped it back into its clips. Now he must wait for the propitious moment to destroy it. Tonight, just as he'd planned, right in the best time of the day.

Alfy laughed at the horn when it roused him in the morning. He sang when he worked all day as he did. He wanted nothing to go wrong so close to his goal. And then it was time, the time he'd risked his life to achieve.

Alfy could not eat, but sat through supper, the chrono-control tiny in his cupped hands, watching its blue pulse come and go, listening to the relays respond, waiting for it to show him the moment of its own destruction. He waited for that magic moment when the rec-drink would be his for the taking, when his food could be had when he wanted it.

The time was close and the skin across Alfy's shoulders felt suddenly taut. He licked his lips. One more pulse . . . Ah . . . now . . .! And Alfy closed his palms on the chrono-control as on a walnut he wanted to crush. And like a walnut, Alfy felt it give under the pressure of his hands.

He opened his palms and stared at the ruined circle in his hands. Its pristine metal was bent, a seam popped open, its shape warped out and the blue glow, that hellish blue glow, was gone.

Alfy threw the ruined control into the air, caught it, shouting. Dancing on one foot, felt it crushing in his

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palms again and again, sent it finally smashing against the now-naked bulkhead.

He stood in the center of the floor, arms flung wide, exulting. The mechanism and the devices that had been his inexorable pace-setters now functioned only to serve him. He was conqueror and master of the capsule—it his slave. He drank and gorged himself on the now constantly available food. He slept and awoke in his own good time. He drank and sang his own praises and drank again.

He ate and slept and drank and slept again and there was no chrono-control now to set him a pace or even to mark for him the passing of the hours.

The prison tender eased alongside Alfy's capsule and connected with it on the fourth try.

"Well done," the warden lieutenant said.

The pilot shrugged and did not answer.

The two capsule technicians checked their clipboards. "Three months and seventeen days," the taller of them said. "He ought to be real glad to see us."

They dogged down the meshed air locks, cracked open the now paired hatches. A blast of music and voices surged out at them.

"Something's wrong," the taller technician said. "He should be on night-set now, but his vid-screen is going full blast."

The guard probed the crack with his ferret-cane warily. "His lights are on, too," he said. He manipulated the cane handle. "Watch it," he said. "He's on this side of the room, standing against the wall."

The lieutenant slid his probe in alongside the guard's, peered at the small screen straddling the handle. "I see him," he said.

The guard slid his pellet-pistol out of its holster and passed it over his shoulder to the pilot.

The lieutenant thumbed his probe's control to a higher magnification. "Watch out for a garrote," he said. "I don't see his kilt."

The guard nodded and flexed his muscles, poising himself to lunge into the capsule and come to grips with the prisoner inside. He was unarmed, his pistol with the pilot in the tender so that if overpowered, he would provide no weapon for a desperate man to use against his mates.

He settled himself and nodded for the tall technician to open the hatches wide.

"Hold it," the shorter technician suddenly said and leaned forward to peer more intently at the lieutenant's probe. "The walls," he said, "they're a mess . . . and the floor, the padding's gone." He sniffed. "His air is breathable, but it sure smells like his decontam units are working overtime."

"I don't know," the lieutenant said. "He hasn't moved a muscle all the while we've been here. I . . . I don't think he's even looking at us."

"Open it up," the guard said. "We have but one way to find out what's going on in there."

The auxiliary breather made talking hard but this didn't stop the guard. He and the taller of the two technicians were to stay with Alfy in his capsule until the lieutenant and the tender got back with someone who could be expected to know more about how to handle the situation. "Did you ever see anything like it?" the guard said, his voice nasal-sounding because of the clip on his nose.

The technician shook his head. He wasn't taking the breather tube out of his mouth against all that stench; it would paralyze him.

The guard moved his feet. Filth and offal squished and slithered beneath his boots. It covered the floor, spattered the circling bulkhead, streaked and smeared the straggle-bearded naked body. "I wonder what happened?" the guard said around his mouthpiece.

The technician looked around the capsule cell. It almost crawled with filth and without the breather the stench would have turned his stomach. The padding was shredded and the timer smashed, but the lights were at their clear-day setting, the rec-drink tap was at Available and the food indicator on Demand. Even the vile air would have been sweet and clear if the prisoner had used the normal disposal unit instead of . . . of— He shook his head and shrugged.

"I don't mean the room," the guard said, pointing at Alfy. "I mean him."

He took hold of Alfy's wrist and raised his arm to shoulder height. He took his hand away and Alfy's arm stayed where it had been put, extended grotesquely, the fingers lax.

He pressed Alfy's arm back down halfway, tilted his head, moved it back and each time Alfy stayed, catatonic, unmoving, the way he had been put.

"He's got no more feeling than a carrot," the guard said. "Did you ever see anything like it?"

The technician shook his head. If ever there was a prisoner in one of these satellites who looked to have it made it should have been this one. He shrugged. Maybe these hard-case escape artists needed some kind of a goal, something to beat, to keep them on the mental beam. Once they made it with no going back, once there was nothing left for them to think about, to strive against . . .

Twenty-four hours a day . . . nothing whatsoever to do . . . nothing to look forward to . . . unable even to tell how many hours have passed—

The technician shivered and coughed a little, suddenly glad that he dealt only with machines and not men's minds. He stood with the guard, the two of them looking at Alfy, waiting. The only sound in the capsule, aside from the whisperings of its beautifully functioning machinery, was the faintly obscene blubbering of the air passing out of the exhaust valves of their breather mouthpieces.

They stood waiting. Waiting for the lieutenant to come back with the tender and the psych-specialist. ■

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THE THIRST QUENCHERS

Earth has more water surface than land surface — but that does not mean we have all the water we want to drink. And right now, America is already pressing the limits of fresh water supply . . .

BY RICK RAPHAEL

ILLUSTRATED BY GEORGE SCHELLING

"You know the one thing I really like about working for DivAg?" Troy Braden muttered into his face-mask pickup.

Ten yards behind Troy, and following in his ski tracks, his partner Alec Patterson paused to duck under a snow-laden spruce bough before answering. It was snowing heavily, a cold, dry crystal snow, piling up inch upon inch on the already deep snow pack of the Sawtooth Mountain range. In another ten minutes they would be above the timberline and the full force of the storm would hit them.

"Tell me, Mr. Bones," he asked as he poled easily in Troy's tracks, "what is the one thing you really like about working for the Division of Agriculture?"

Troy tracked around a trough of bitterbrush that bent and fought against the deep snow. "It's so dependable," he said, "so reliable, so unchanging. In nearly two centuries, the world has left behind the steel age; has advanced to nucleonics, tissue regeneration, autoservice bars and electronically driven yo-yos. Everyone in the world except the United States Division of Agriculture. The tried and true method is the rock upon which our integrity stands—even though it was tried more than a hundred years ago."

He dropped out of sight over a small hummock and whipped down the side of a slight depression in the slope, his skis whispering over the dry snow and sending up a churning crest of white from their tips.

Alec chuckled and poled after him into the basin. The two young junior hydrologists worked their way up the opposite slope and then again took the long, slow traverse-and-turn, traverse-and-turn path through the thinning trees and out into the open wind-driven snow field above them.

Just below the ridgeline, a shelf of packed snow jutted out for a dozen yards, flat and shielded from the wind by a brief rock face. Troy halted in the small island in the storm and waited for Alec to reach him.

He fumbled with mittened fist at the cover of the directional radiation compass strapped to his left wrist. The outer dial rotated as soon as the cover lock was released and came to a stop pointing to magnetic north. The detector needle quartered across the northeast quadrant of the dial like a hunting dog and then came to rest at nineteen degrees, just slightly to the left of the direction of their tracks. An inner dial needle quivered between the yellow and red face of the intensity meter.

"We should be within a couple of hundred yards of the marker now," Troy announced as his short, chunky partner checked alongside. Alec nodded and peered through the curtain of sky-darkened snow just beyond the rock face. He could see powder spume whipping off the ridge crest twenty feet above them but the contour of the sloping ridge was quickly lost in the falling snow.

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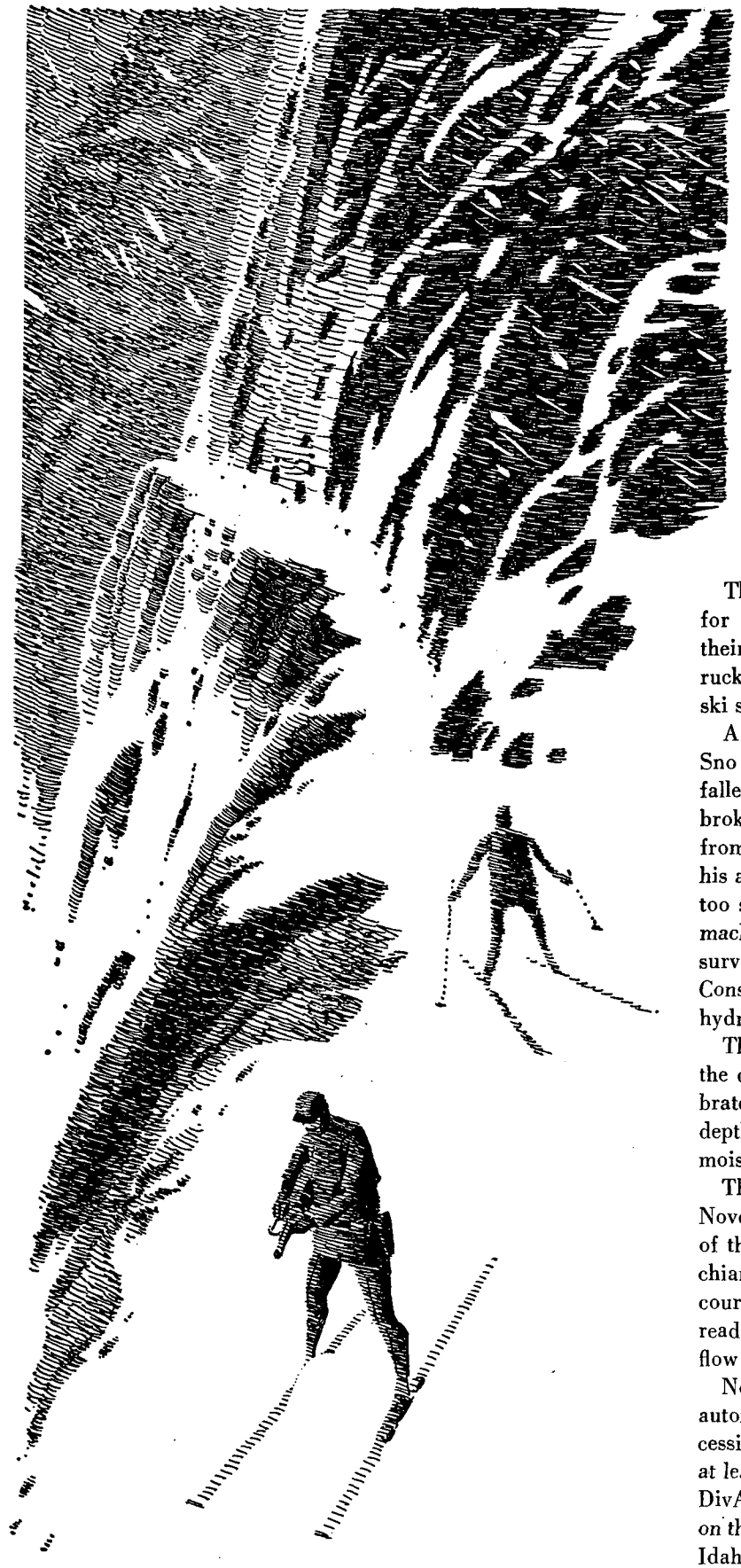

The hydrologists leaned on their ski poles and rested for a few minutes before tackling the final cold leg of their climb. Each carried a light, cold-resistant plastic ruckpac slung over their chemically-heated lightweight ski suits.

A mile and half below in the dense timber, their two Sno cars were parked in the shelter of a flattened and fallen spruce and they had thrown up a quick lean-to of broken boughs to give the vehicles even more protection from the storm. From there to the top, Troy was right in his analysis of DivAg. When God made mountain slopes too steep and timber too thick, it was a man and not a machine that had to do the job on skis; just as snow surveyors had done a century before when the old Soil Conservation Service pioneered the new science of snow hydrology.

The science had come a long way in the century from the days when teams of surveyors poked a hollow, calibrated aluminum tube into the snow pack and then read depth and weighed both tube and contents to determine moisture factors.

Those old-timers fought blizzards and avalanches from November through March in the bleak, towering peaks of the Northwest to the weathered crags of the Appalachians, measuring thousands of predesignated snow courses the last week of each winter month. Upon those readings had been based the crude, wide-margin streamflow forecasts for the coming year.

Now, a score of refined instruments did the same job automatically at hundreds of thousands of almost-inaccessible locations throughout the northern hemisphere. Or at least, almost automatically. Twenty feet above the two DivAg hydrologists and less than a hundreds yards east, on the very crest of an unnamed peak in the wilderness of Idaho's Sawtooth Mountains, radiation snow gauge P11902—87 had quit sending data three days ago.

The snow-profile flight over the area showed a gap in

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the graphed line that flowed over the topographical map of the Sawtooths as the survey plane flew its daily scan. The hydrotech monitoring the graph reported the lapse to regional headquarters at Spokane and minutes later, a communications operator punched up the alternate transmitter for P11902–87. Nothing happened although the board showed the gauge's cobalt-60 beta and gamma still hot. Something had gone wrong with the tiny transducer transmitter. A man, or to be more precise, two men, had to replace the faulty device.

The two men and the replacement gauge, trudged out again into the face of the rising storm.

Troy and Alec pushed diagonally up the snow slope, pausing every few minutes to take new directional readings. The needles were now at right angles to them and reading well into the "hot" red division of the intensity meter. They still were ten feet below the crest and a cornice of snow hung out in a slight roof ahead of them. Both men had closed the face hatches of their insulated helmets and tiny circulators automatically went to work drawing off moisture and condensation from the treated plastic.

"Wonder if that chunk is going to stay put while we go past," Alec called, eying the heavy overhang? Troy paused and the two carefully looked over the snow roof and the slope that fell away sharply to their right.

"Looks like it avalanched once before," Troy commented. "Shall we operate, Dr. Patterson?"

"Better extravagant with the taxpayers' money than sorry for ourselves," Alec replied, pulling the avalanche gun from his holster. It looked like an early-day Very pistol, with its big, straight-bore muzzle. "Let's get back a couple of feet."

They kick-turned and skied back from the sides of the cornice. Alec raised the gun and aimed at the center of the deepest segment over the overhang. The gun discharged with a muffled "pop" and the concentrated ball of plastic explosive arced through the air, visible to the naked eye. It vanished into the snow roof and the men waited. Ten seconds later there was a geyser of flame and smoke and snow as the charge detonated deep under the overhang. The wind whipped the cloud away and the roof still held, despite the gaping hole.

"What do you think?" Troy asked.

"One more for good measure," Alec said as he fired again, this time to the right of the first shot. The plastic detonated in another geyser of smoke and snow, but the small cloud was instantly lost as the entire overhang broke loose with a roar. Hundreds of tons of packed snow broke and fell the ten to twelve feet from the crest to the face of the slope and then boiled and rolled, gathering more snow and greater mass and impetus as it thundered down the slope and was lost in the storm. The dense clouds of loose powder snow raised by the avalanche whipped away in the clutches of the wind.

"Well done, Dr. Patterson," Troy called as he leaned into his poles and moved out across the newly-crushed snow on the slope.

"Thank you, Dr. Braden," Alec called in his wake, "you may proceed to the patient."

They worked past the buried radiation gauge to the crest and then turned and came slowly back along the wind ridge, following directly behind the detection needle. Troy glanced at his intensity gauge. The needle was on the "danger" line in the red. He stopped. Behind him, Alec checked his drop slowly down the windward side of the slope, reading his own meter. When his intensity needle hit the same mark, he, too, halted about thirty feet to Troy's right.

"I'm dead on," Troy said, indicating with a ski pole an imaginary line straight ahead.

"I've got it about forty-five degrees left," Alec called, marking his position and a directional line in the crust with a pole. Each moved towards the other and from the mid-point of their two markings extended with their eyes the imaginary lines to an intersecting point some thirty feet from Troy's original sighting.

"Hand me the heat tank, doctor," Troy said, turning his back to Alec, "so that we can excavate the patient." Alec unclamped a hand tank and nozzle device from his pack.

With the tank slung under his arm and with nozzle in hand, Troy moved forward another ten feet, gauging the wind velocity. He aimed to the windward of the intersecting lines and triggered the nozzle. A stream of liquid chemical melting agent shot out into the wind and then curved back and cut a hole into the snow. Troy moved the nozzle in a slow arc, making a wide circle in the snow. Then he cut a trough on the downhill side for more than twenty feet. He adjusted the nozzle head and a wider stream sprayed out to fall within the already-melting circle. The concentrated solution was diluted with melting water and spread its action. As the hydrologists watched, the snow melted into a deep hole and the chemically-warmed water torrented down the drain cut to gush out onto the snow slope and quickly refreeze as it emerged into the sub-zero air.

Troy shut off the liquid and the two men waited and watched. "The gauge was recording ninety-seven inches of pack when it quit," Alec said. "Better give 'er another squirt."

Troy fired another spray burst of chemical into the now-deep hole and then widened the drain trough once more.

Then he began spraying a three-foot wide patch from the edge of the hole back towards himself. Immediately a new trough began to form in the snow pack and the water poured off into the hole surrounnding the buried gauge.

While the snow was melting, Alec had removed his skis and stuck them upright in the snow. He dropped his pack and unfastened a pair of mountain-climber's ice crampons and lashed them to his ski boots. In five minutes Troy had "burned" a sloping, ice-glazed ramp deep into the

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snow field, sloping down into a ten-foot deep chasm and terminating on bare wet soil. Sitting on the ground, slightly off center to one side of the original hole was the foot-round gray metal shape of radiation snow gauge P11902–87. A half-inch round tube projected upwards for three inches from the center of the round device.

Alec was down in the ice chasm, ski pole reversed in his hand. Standing as far from the gauge as possible, he dangled a leaden cap from the end of his ski pole over the projecting tube. On the third try, the cap descended over the open end of the tube, effectively shielding the radioactive source material in the gauge. Once the cap was in place, Alec moved up to the gauge and put a lock clamp on the cap and then picked up the gauge and moved back up the ramp.

The wind was screaming across the top of the slot in the snow pack as he pushed the device over the edge and then heaved himself out into the teeth of the storm.

He could barely make out the form of Troy fifty feet east of the original position of the gauge. The tall engineer had taken the replacement gauge from his pack and was positioning it into the snow on the surface of the snow pack. The replacement was bulkier than the defective unit and it was different in design.

This was a combination radiation-sonar measuring gauge. Placed on top of an existing snow field, its sonar system kept account of the snow beneath the gauge to the surface of the soil; the radiation counter metered the fresh snow that fell on it after it was placed in position. The two readings were electronically added and fed into the transducer for automatic transmission.

Troy hollowed out a slight depression in the fresh snow and pressed the gauge into the hollow, then packed the snow back around it to keep it from being shifted by the high velocity winds until fresh snows buried it. Satisfied that it was properly set, he removed the radiation cap lock and slipped his ski pole through the ring on the cap. He backed away, lifted the cap from the gauge and then quickly moved out of the area.

Alec had stowed the bad gauge in his pack and removed a pressure pillow gauge to put into the deep hole in the snow. The man-cut chasm would serve as a partial gauge hole and, from a purely research point of view, it would be interesting to know how much snow would drift and fall back into the hole. The pressure pillow contained a quantity of antifreeze solution and some air space. As the snow fell upon the pillow and piled up, its weight would press down and the pressure upon the pillow would be measured by instruments and again relayed to a small transmitter for reading back at Spokane. The pillows were used in many flat open areas where snow pack was uniform across a large level surface.

The pillow in place, Alec again climbed from the chasm and was locking on his skis when Troy slid up. The ice-dry snow was driving almost horizontally across the face of the ridge and the two engineers had to lean into the force of the wind to keep their balance. Troy fumbled a small service monitor from his parka pocket and shifted it to the new radiation gauge frequency. The signal was steady and strong and its radioactive source beam was hot.

"Now is the time for all good snow surveyors to get the hell outta here," Alec exclaimed as he slipped his ruckpac onto his shoulders. "The gauge O.K.?"

Troy glanced once more at the monitor and nodded. "Hot and clear." He shoved the monitor back into his pocket and grasped his ski poles. "Ready?"

"Let's go," Alec replied.

Turning their backs into the wind, the men veered sharply away from the site of the new gauge and dropped off the crest of the mountain top back to the lee side of the slope. Out of the worst of the wind, they skied easily back down towards the timberline.

Once back among the trees, the visibility again rose although the going was much slower. It would be dark in another two hours and they wanted to be back at the Sno cars with enough light left to pitch camp for the night.

"I heard of a guy over in Washington," Troy said as they worked their way down through the trees, "that won the DivAg award as the most absent-minded engineer of the decade."

"Since you never tell stories on yourself, it couldn't have been you," Alec quipped, "so what happened?"

Troy schussed down an open field in the trees and snowplowed to a slowdown at the opposite side to once again thread through the dense spruce and pine.

"This joker did the same job we just finished," he continued. "He put the new gauge in place while his partner fished the old one out. Then he forgot that he had put the new gauge in place, uncapped mind you, and when they took off he skied right over it."

"Right over the top of it," Alec gasped.

"Yup," Troy said.

"What happened to him?"

"Nothing to speak of. Of course, he's the last of his family tree—genetically speaking, that is."

Fresh snow had completely covered their tracks made during the climb to the summit, but they wouldn't have followed the same trail back down in any case. Both men were expert skiers and they cut back down the shortest route to the Sno cars. A faint audio signal sounded in their right ears from the homing beacons in the snow vehicles. As they shifted directions through the trees, the signal shifted from ear to ear and grew stronger as they neared their cache.

A few minutes later they broke out into the edge of the small clearing with its downed spruce and the two Sno cars. From the carriers they extracted light-weight collapsible plastic domed shelters. A half hour later the domes were joined together by a two-man shelter tube and their sleeping bags were spread in the rear dome. While Alec was shaking out the bags and stowing gear,

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Troy set up the tiny camp stove in the front dome, broke out the rations and began supper. The detachable, mercury-battery headlight from one of the Sno cars hung from the apogee of the front dome and the other car light was in the sleeping dome.

By the time they had finished eating, the wind had died but the snow continued to fall, piling up around the outside of the plastic dome as it drifted and fell. Its sheltering bulk added to the already near-perfect insulation of the domes. The outer air temperature had fallen to minus fifteen degrees but the temperature below the surface of the snow held at a constant twenty-five degrees above zero and within the front dome with its light and stove, it was a warm seventy-five. The excess heat escaped through a flue tube in the top of the dome.

Both men had stripped down to shorts and T-shirt and now quietly relaxed.

"That's a goodly amount of precip piling up out there," Alec remarked languidly. "God knows we can use it."

"If this keeps up all night," Troy said, "we may have to dig ourselves outta here in the morning." He leaned back and surveyed the rounded roof above him. "Remember what I said this afternoon about nothing ever changing in DivAg?"

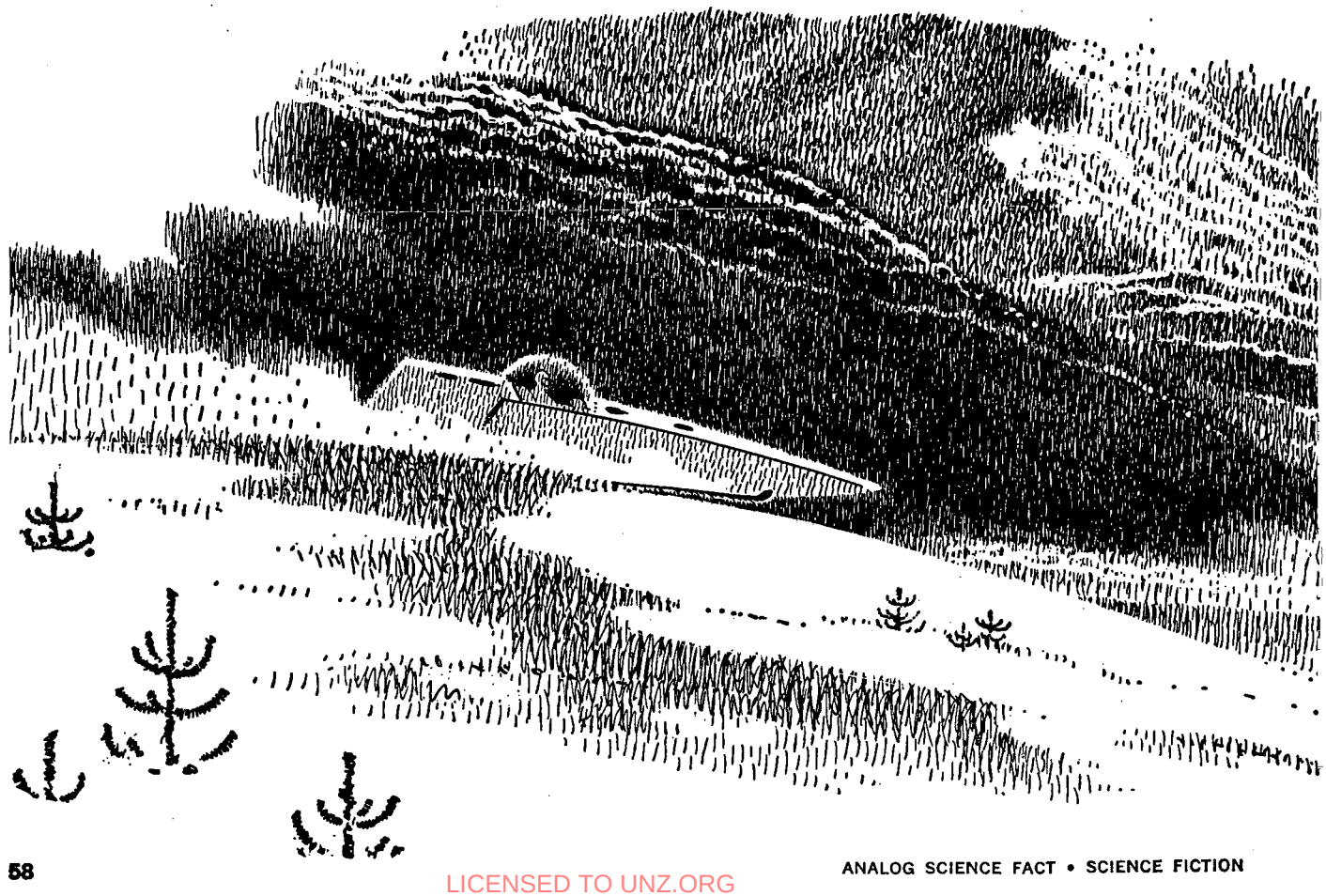
Alec nodded.

"Well, sir, here's another fine example of progress halted dead in its tracks," the lanky hyrdologist went on. "For centuries the Eskimos have lived through Arctic winters in igloos, made of snow blocks, cut and rounded to form a cave in the snow.

"What's good enough for the Eskimos is good enough for DivAg. Here we are right back in the Ice Age, living in an igloo. If that stove used blubber or seal oil instead of chemical fuel, the picture would be complete."

Alec grinned. "Just because something is old doesn't mean it's no good, Dr. Braden," he said. "The Eskimos proved the efficiency of the igloo. We've just adopted the principle and modernized it. It still works better than any other known snow-weather shelter. But I didn't see you cutting any snow blocks with your skinning knife to build this snug haven, nor crawling for hours on your belly across the snow to sneak up on a seal for your supper."

"Technicalities," Troy scoffed lazily. "The point is, that here we are living almost under the same conditions that the primitive savages of the frozen north lived under for centuries." He belched gently and stretched his long legs luxuriously away from the webbing of the bucket camp chair.



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"I must say that you seem to be enjoying it," Alec commented. "Primitive or not, I still like this better than those rat warrens they call cities today."

Nearly two miles above them, the replacement snow gauge, C11902–87, already buried in a half-foot of new snow, sent out a strong and steady signal. At midnight, when both snow hydrologists were sleeping soundly in their bags, hundreds of miles away in regional survey headquarters at Spokane, the huge electronic sequencer began its rapid signal check of each of the thousands of snow gauges in the five-state area of Region Six.

A dozen red lights flicked on among the thousands of green pinpoints of illumination on the huge mural map of the area indicating gauges not reporting due to malfunctions. The technician on duty compared the red lights with the trouble sheet in his hand. He noted two new numbers on the list. When he came to C11902–87, he glanced again at the map. A minute, steady green ray came from the tiny dot in the center of a contour circle that indicated a nameless peak in the Sawtooth Range.

The technician lined out C11902–87 on the trouble chart. "They got to that one in a hurry," he murmured to himself. Another figure had been returned to the accuracy percentage forecasting figures of the huge computers that dictated the lives and luxuries of more than a half a billion Americans.

Water, not gold, now set the standard of living for an overpopulated, overindustrialized continent, where the great automated farms and ranches fought desperately to produce the food for a half billion stomachs while competing with that same half billion for every drop of life-giving moisture that went into the soil.

In the winter, the snows and early fall rains fell in the watershed mountains of the continent, then melted and either seeped into the soil or first trickled, then gushed and finally leaped in freshets down from the highlands to the streams and rivers. As the great cities spread and streamflow waters were dammed and stored and then metered out, there was no longer enough to meet agricultural, industrial and municipal needs.

The cities sent down shaft after shaft into the underground aquifers, greedily sucking the moisture out of the land until each day, each month and each year, the water tables fell deeper and deeper until they, too, were gone, and the land was sucked dry.

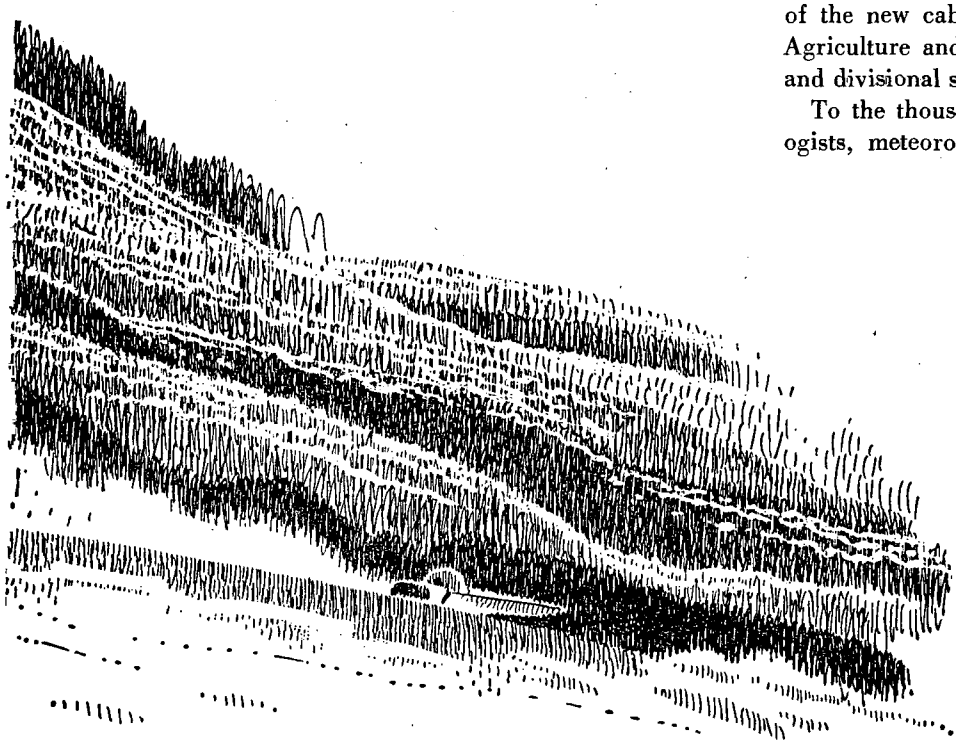
There was water in the highlands, in watersheds and spilling unused down to the sea in many areas. Soon the cities and industries sent out great plastisteel arteries to bring the lifeblood of the land to the vast sponges of the factories and showers in homes and food-processing plants and laundrounits. Water for the machine-precise rows of soy bean plants and for babies' formulas and water for great nuclear power plants and water for a tiny, sixty-fifth floor apartment flower box.

But there was never enough and a nation finally could no longer evade the situation that had been forewarned and foredoomed a century earlier by the pioneers of conservation.

Only by total conservation of every possible drop of moisture could the nation survive, and to conserve, it is first necessary to have an accurate and constantly-current inventory of the substance that is to be conserved.

To the executive branch of the government had come the Secretary of Water Resources, and with the creation of the new cabinet office, the former cabinet posts of Agriculture and Interior were relegated to subordinate and divisional status.

To the thousands upon thousands of trained hydrologists, meteorologists and agronomists of the federal



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agencies of agriculture, interior and commerce fell the task of manipulating and guiding the delicate balance of the world's water cycle. The snows and rains fell upon the earth, to soak into the land, flow down the streams and rivers to the sea or to the great lakes, and then be returned to the atmosphere to fall again in the ageless cycle of life.

But the happenstance habits of nature were steadily being integrated into the control program of man. The rains and snow still fell where nature intended but man was now there to gauge and guide the moisture in a carefully controlled path through its cycle back to the atmosphere.

An inch or an acre-foot of water falling as snow upon the high mountains was used over and over many times and by many persons before returning to its starting place in the atmosphere.

With the age of nuclear power, the need for hydroelectric sources vanished and with it went the great dams and reservoirs with their vast, wasteful surfaces of open water that evaporated by the thousands of acre-feet before ever being utilized by man. The beds of the great rivers were dry and the cities spread upon them together with the new controlled auto-farms. Only the smaller rivers and streams continued to flow until they reached a predesignated flow force. Then they vanished, spilling down into tunnels and flowing for hundreds of miles along subterranean aqueducts into great storage reservoirs beneath the surface of the land and protected from the drain of the sun and wind. From these, each precious drop of water was rationed upwards to meet the increasing needs of the people. And still there was never enough.

It was still snowing when Troy and Alec awoke in the morning. The snows had drifted over both the domes on the windward side. They cooked a quick breakfast and then Alec began stowing the camp gear into its compact containers. Troy took a small hand shovel and crawled out through the double opening of the front dome and tunneled his way up out of the snow. Twin plumes of vapor rose through the snow that curved in gentle hummocks over the buried domes. The tall engineer shoveled a short path to the downed spruce and cleared the way into the shelter where the Sno cars waited. He removed the protecting boughs and shoveled a short ramp out of the trough to the surface of the snow.

The temperature had risen during the night and the snow had changed from the crystal dry powder of the night before to fluffy, gentle flakes, falling in a steady curtain through the trees. Troy opened the side hatch of the bubble canopy of his Sno car and climbed in. He slid into the single bucket seat and with a flick of his finger set the tiny reaction motor into operation. Moments later heat filled the bubble and a cloud of steam moisture flared from the thrust pipes.

The ten-foot-long tapered Sno car sat on twin broad-planed skis in front with a single retractable wheel raised between them for snow travel. At the wider rear, another pair of short, broad ski blades rested on the surface of the snow on either side of a wide, continuous track assembly. A pair of handle bars, much like an early-day motorcycle, extended into the bubble from the front fork. The grips were studded with additional control buttons. Troy pressed one and the two rear skis rose on outrigger arms like a small catamaran to allow the Sno car to sink a couple of inches back onto the gripper track.

As the weight of the vehicle shifted to the track assembly it automatically diverted the tiny nuclear engine output from jet thrust to gear box drive. Troy settled himself in the seat and increased the power. The track started to turn and the Sno car glided slowly out from under the protecting branches and churned up the slight ramp to the top of the snow pack. He turned the front skis and plowed to a halt beside the tunnel into the domes.

Alec emerged with one of the camp kits and handed it up to his partner, then went to the shelter for his own Sno car. Troy stowed the kit in the carrier and dismounted and began digging snow away from the domes. Alec's Sno car pulled up alongside and the chunky engineer vanished once more into the domes to emerge with his own kit. Then he joined Troy in the digging operation. Fifteen minutes later, both domes were collapsed and stowed in the carriers. The men boarded their vehicles.

Inside the warm bubble canopies, air circulators kept the plastic free of condensation. Outside, the snow glanced off the treated surface, keeping it clear.

"Lead off, Dr. Patterson," Troy called out over the car radio.

Alec increased power and the track of his Sno car dug into the soft surface, then caught and the vehicle moved forward and into the trees. Troy fell into line behind the other vehicle as they drove down the gentle slope towards the snow-covered access trail another mile below them on the side of the mountain.

Out of the trees and onto the trail, both drivers shifted gears, dropping rear skis to the more solid pack of the trail and sending jets of steam shooting out from the thrust tubes of the Sno cars. Troy dropped back to stay out of Alec's vapor cloud as they now glided smoothly and easily along the trail. A bright red metal pole, topped by a small housing and antenna came into view on the side of the road. The tube went down through the snow and deep into the soil of the mountain side. Inside, electrostats read soil moisture at depths up to thirty feet and transmitted the information on automatic or demand signal.

Ahead, the vapor cloud from Alec's Sno car vanished as the trail dipped down the side of the mountain and the driver cut his thrust to let the momentum carry him on the twin sets of skis. Troy gunned his car for a final burst of speed then cut rear drive and dropped swopingly down the grade, whipping along in Alec's tracks. The trail curved sharply ahead and Troy gently manipulated the front fork skis into a snowplow to cut speed. His

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fingers rested lightly on the pressure switch that would open small scoops on the under surfaces of all skis for additional braking power. As a final resort, the engine thrust could be shifted from rear to forward reaction to bring him to a complete stop and even send the car backwards.

The Sno car whipped around and down the trail. As the roadway swung to the south slope of the range, the track in the fresh snow cut by the lead vehicle turned dark gray and then almost black. When the present storm had ended and before new snow fell again, the south slopes would again be stained with clouds of black, monomolecular film, gushing out in clouds behind spray jets of the survey planes. Each successive layer was treated, lessening the evaporative surface effects of the sun upon the south slopes and holding as much of the moisture-giving snow to the earth for controlled runoff. A pair of fresh elk-tracks came down the side of the mountain and cut across the trail and Troy braked to peer through the trees for a glimpse of the animals. But they had vanished, frightened by the sudden intrusion of the men.

A half hour later and four thousand feet lower, the trail joined a wider and more traveled road. Alec turned onto the road and increased speed. A few minutes later, the Sno cars flashed by a sign reading "Elk City—4 miles." Alec cut speed and waited for Troy to pull alongside, then the two cars glided slowly to the edge of the wilderness community. At the outskirts of the little town the snow on the road came to an abrupt end. Chemically-treated paving kept the roadways warm and bare of snow. Ahead, the pavement into town was wet and glistening and even falling snow had stopped. Rear skis were again retracted and the front wheels lowered for non-snow driving and then the two vehicles rumbled slowly into Elk City.

They came to a halt at the ranger station and dismounted.

"Let's call for a taxi and then go for a cup of coffee and another bite," Troy said. "I'm starved again."

"You and that hollow stomach to match your head," Alec grunted.

They entered the ranger station. Behind the counter, one of the four rangers on permanent duty at the station was transferring a radar storm plot onto a weather chart. He glanced up as the two men entered.

"Back so soon," he commented. "That was a quick trip. Get the job done?"

"Neither rain, snow or sun stops the Division of Agriculture in its appointed rounds," Troy said flippantly. "Harry, call Spokane and tell 'em we're ready for a pick-up, please."

The ranger reached for a mike. "Spokane Region," he called, "this is Elk City station."

"This is Spokane," came the reply.

"Your two snow boys are here," Harry said, "looking for a lift. Can you send a 'copter after them?"

"Affirmative, Elk City," Spokane communicator replied. "We'll pick them up in about forty-five minutes."

"Thanks, Harry," Troy said. "We're going to take a walk uptown and get something to eat. If the chopper should get here sooner, tell him we'll be right back."

"O.K.," the ranger said, "but there's a pot of coffee on the stove in the kitchen if you want to save yourself the walk."

Alec grimaced. "I had a cup of that concentrated sulphuric acid you call coffee on the way up," he said. "No thanks, anyway. What do you make that stuff out of? Leftover road oil?"

"Man's drink for a real man," the ranger grinned. "Us forestry men learn to make coffee from pine pitch. Makes a man outta you."

"Huh," Alec sniffed as they turned to leave, "pine pitch is just sap and anyone who'd drink that stuff deserves the name—'sap' that is."

The ranger grinned as the hydrologists walked out.

Troy and Alec were walking back up the street to the station when the big cargo copter settled down to the pad at the rear of the station. They hurried their pace and got to their Sno cars. By the time they had driven around to the pad, the copter crew had lowered the ramp and they drove directly up and into the craft. A row of front-wheel racks studded the after wall of the cargo deck and Troy and Alec nosed their Sno cars into the racks. By the time they had cut power and climbed out, the crewmen had cargo locks on both vehicles.

The crew chief closed the ramp and punched a signal button. As Troy and Alec climbed up the gangway to the crew-passenger deck, the big jet rotors were already churning and the copter lifted into the again lightly falling snow.

The hydrologists settled into seats for the short ride to Spokane. The copter swung to the northwest, roaring a thousand feet above the snow-covered mountain tops. They soared over the Clearwater River that flowed to its confluence with the once-mighty Snake River at Lewiston where both vanished into a subterranean aqueduct. As they neared Spokane, the country began to flatten out into the great Columbia basin, where once nearly a fifth of the nation's entire electrical output was produced in a series of hydroelectric dams on the great river and its tributaries. A century ago, high tension power transmission lines and towers laced the face of the nation, carrying power from the waterways to the wheels of industry and cities hundreds of miles away. Like the dams, they, too, were gone and each industry and metropolis and village generated its own power with compact nuclear reactors.

The copter dropped down into an airways lane as it came over the edge of the suburbs of Greater Spokane. The air lane followed almost directly above one of the crowded ten-lane North American Continental Thruways that cut five-mile wide swaths across the continent from Fairbanks to the southern borders of Mexico; from San

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Francisco to Washington, D.C., and from Montreal to Vancouver.

As the chopper settled down over the heliport at Region Six headquarters, Troy and Alec climbed back down to the cargo deck and went to their Sno cars. On the ground, the ramp came down and they drove out of the copter and across the pad towards Snow Hydrology Section's motor park. The Sno cars were parked in the garage for a service check and with their ruckpacs slung over one shoulder, they headed for the offices.

The prominent peak of Mount Spokane north of the city gleamed intermittently as the sun began to break through the remnants of the storm now blowing away to the east.

"I hope I don't get transferred out of the Region," Alec said moodily as he surveyed the distant mountain.

"Why should you?" Troy asked.

"You never know what's going to happen when you step up a notch," Alec replied. "You know that both of us are due for grade promotion sometime this year to senior status. Depends on how many Grade One senior hydrologists they need in the Region."

"Snow is snow," Troy shrugged. "It doesn't really make that much difference to me. If they want me to move, I'll move."

"It doesn't make much difference to you," his partner said, "because you're not married yet. But with Carol and Jimmy, it makes a lot of difference to me. It's bad enough living like we do here, jammed in against five hundred other families in the complex. The only thing that makes it worthwhile is the chance to get away from the city with the family on our days off. I want that kid of mine to know what real country looks and feels like. God help him if I should get transferred back east."

"You could always resign," Troy said half seriously.

Alec stopped dead in his tracks and turned to stare at him. "Are you out of your mind," he cried. "Resign from this for what? For the chance to be buried in a city or a bureau for the rest of my life? Never to see the mountains except on rare vacations and then with a guide on my back? Never to see a river flowing or fight a trout? Have my kid grow up with his only knowledge of the woods from history books with an occasional trip to the zoo to see what a deer or elk looks like. I'd rather half-starve as an autologger operator in some gyppo timber camp than live like that."

"I was just kidding," Troy said. "When it comes right down to it, I wouldn't be happy away from this either. Come on, let's check in with the 'Scourge of the Northwest.'"

At SHS headquarters, they dropped their ruckpacs by the door and Alec fished the faulty radiation gauge from his pack. Then they went in to report to Snow Supervisor Morley Wilson, known affectionately to his subordinates as "The Scourge."

The leather-textured face of the senior engineer turned up at them as they entered his office. Wilson's face was tanned and weather-beaten by the sun, wind and snows of a thousand mountains and it was rumored that when he went up for annual physical examination, the lab merely ran pollution tests on the ice water that flowed in his veins instead of blood.

"I didn't expect you two back so soon," he said with a scowl. "What's the matter? Couldn't you get to the gauge?"

Alec laid the faulty device on Wilson's desk. "No trouble, boss. Just speedy work by your best juniors."

Wilson snorted. "You must have had the chopper land you on the ridge in spite of orders." He reached for the gauge. Troy and Alec exchanged smiles. The old man had received a full report of the conditions in the Sawtooths together with a check on their activities at least an hour ago. He knew what they had to contend with to switch the gauge—and he knew they knew he was just barking.

"Another one of those transmitters shot again," he muttered. Wilson punched the intercom on his desk. "Shaver," he called, "get up here and get this radiation gauge you said was so good."

In the communications repair section three levels underground, the senior comm tech snapped out a fast "yessir" and bolted for the door.

"What did you leave up there?" Wilson asked.

"We put a C-S gauge thirty feet from the survey point," Troy said. "It was working fine and it's on a flat shelf with virtually the same pack and strata formation this one came out of."

"What's it look like up there," Wilson asked. The supervisor was nearing the end of forty years of service with Snow Hydrology and in his early days, the last vestiges of the crude "man-on-the-spot" surveys were still in operation.

Despite loud and emphatic defense and reliance on the new and complex techniques of electronic measurements, he still felt the need to feel the texture of the snows himself and to observe with his own eyes the sweep of a snow pack molded against the shoulder of a towering crag. Chained to the desk by responsibility, he used the eyes of his junior engineers and surveyors to keep a semblance of the "seat of the pants" technique of forecasting that he

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had lived with and lived by.

"The pack is good," Alec reported, "and what we saw of the south slopes is holding well. It was snowing from the time we got into the area until we pulled out this morning, so we didn't really get a long sighting. But what we saw looked fine."

The old man nodded with satisfaction. "You two go get out of that field gear and then report back here in an hour. We've got a staff conference and I want you two in on it." He dismissed them with a wave of his hand and went back to the reports piled on his desk.

In the locker room, Troy and Alec peeled out of the snowsuits and changed into street clothes. "I wonder what's in the wind," Troy asked thoughtfully. "Must be something big enough to bug the old man into brain-picking, otherwise he'd never stoop to juniors before making a decision."

"Probably just wants to set up next summer's vacation schedule," Alec grunted as he bent over to slip on his shoes. "You can bet that if it were something important, he'd never be concerned with the opinions of the likes of us."

An hour later they walked back into the supervisor's office to find it jammed with the heads of all sections together with leading techs and junior engineers. "Go next door and grab yourselves a couple of chairs," Wilson barked, "and then get back in here."

When the full staff was assembled, Wilson stood up and faced the group.

"This won't take too long," he began, "but it's a problem that I want all of you to be considering during the next fifteen days because we have to come up with a reasonable solution to the problem—just another one that's been dumped in our laps."

He pressed a button on his desk and a mural, three-dimensional topographical map of the five-state Region Six flashed on the wall behind him. Across the top of the map was a line of illuminated numerical panels that shifted in values before their eyes, changing with the factor information constantly being fed into the computers. These were the constant monitoring reports from the regional computers on snow pack, moisture content, streamflow, water consumption and others that formulated the equations that the forecasters and ration controllers used in determining water supply allocations.

Hundreds of multi-colored lights on the map indicated industrial, municipal, domestic and agricultural water use facilities.

"We've been asked to assist in a critical situation in Region Five," Wilson continued. Region Five included California, Nevada, Arizona and Utah. "As you've seen from the combined western forecasts, snow pack has been much below normal this year in Region Five and has for the past three years. We've been piping a lot of water

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down the line and so far, they've been able to meet demands. But a new factor has entered.

"For the past three years, again as many of you are aware, Space Department has been gearing for the start of Venus Colony. I'm no expert in this field but from what friends of mine who are closely associated with the project tell me, there's a big difference in building a vehicle to carry a survey and exploration team and the technology involved in building both vehicles and life-support equipment for a colony operation. All of which leads up to the current problem.

"Our friends in Space have now firmed up the specialized equipment they want and the quantities. Prototype of all of this gear have been built and tested, mostly fabricated by the Southern California Space and Electronics Complex. Now they're ready to go into production. But the fly in the ointment is that it calls for five new production units.

"With the Southern Cal Complex operating under water deficits plus transmission costs for the past three years and with no improvement in sight, they just don't have the water to handle five more major industrial units. Their population census is also up again. This means the units will have to be located somewhere else, possibly only until the production schedule is completed; possibly on a permanent basis if Venus Colony pans out. The trained manpower pool is in Southern Cal Complex and it will have to be displaced to wherever the units are located."

Wilson paused for a moment and looked around the room.

"I can see that you're way ahead of me. And you're right. We've been asked to make a projection to determine if we can handle them in Region Six, preferably in the Portland-Seattle Industrial Complex or near thereto."

He indicated a stack of bound manuscripts on his desk. "These are copies of the full prospectus of the proposed units; power output, equipment, manpower, water absorption, water return, domestic and municipal demands, et cetera, for the project.

"I want each of you to take a copy, study it in light of your specialty, and then submit your recommendations to your department and section chiefs within the next ten days. The departmental and sectional reports will be consolidated for my study and then we'll make our report to Washington.

"But let me give you this parting thought to keep foremost in your consideration. In all probability, whether we agree to it or not, we're going to get stuck with the units. We have the most dependable water recharge in the nation and we have the physical space for the units. Dislocating and trying to relocate just the people involved in this project is a monumental thing in itself and would be a virtual impossibility east of the Mississippi. You can bet your last cent that this was all taken into account before Washington ever politely suggested that we review the situation and give our opinion.

"I don't think they give a damn about our opinions. They just want to see how lavishly they can operate with what we offer. So bear that in mind for my information. I need to know as close to the absolute last drop of moisture where this is going to put us and where we have to shut down and cut corners throughout the Region to accommodate the new industry.

"Now we're not going to get this solved or anything else done by my talking about it. Get out of here and back to work. You've got ten days to come up with the answer and you can expect to be saddled with the additional production units within one hundred twenty days. That's all gentlemen except to say that, as occurred when I asked you two years ago for a similar projection for the laser unit complex, I will not accept any solutions calling for a pogrom of all Anglo white Protestants between the ages of six and sixty."

The meeting broke up in laughter as the engineers crowded up to the desk to pick up copies of the prospectus.

Troy and Alec fell into step with Jordan Plumber, their section chief.

"One thing you have to admire in the old man," Alec commented, "he has faith in his staff to come up with the answers."

"Hm-m-m," Plumber sniffed, "he doesn't need faith. He's a realist from the old school. He knows that we have no choice and all that's left is to come up with a formula for living with the situation. It doesn't bother him a bit how we figure this one. He knows we have to work it out."

Back at their combination laboratory and office area, the trio split up to their respective cubicles to go over the report. Troy and Alec, as semispecialists in snow depth and moisture gauges, would study the problem from the viewpoint of increasing the accuracy and volume of their instruments in inventorying Region Six snowfall. Other members of the headquarters staff would tackle it from soil moisture content; stored water capabilities; increasing domestic, municipal and industrial water economies; while the meteorology men would venture even farther into left field via data, formula and Ouija board, to increase the potential future limits of their forecasts.

The key to the entire problem lay in streamflow forecasting. Accuracy in predicting the amount of water entering the vast underground reservoirs now had reached ninety-eight point three per cent. Yet in the remaining one point seven per cent was the equivalent of more than seventy-five million acre feet of water. The question now was—how much more water would the new units require and could the forecast be projected another tenth or more percentage points closer to supply than demand.

That was the basic problem. There were thousands of allied problems involved, ranging from where and how the additional water would be stored and channeled and how it could be used after the new factories had had initial use.

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At 1630, Alec stuck his copy of the prospectus, together with some other more pressing reports, in his briefcase and headed for home. He stopped in the door to Troy's cubicle.

"You going to work all night?" he asked.

Troy swung his feet down from his desk and snubbed out his cigarette. "Nope," he replied, "but I thought I'd finish reading this before I shoved off. After all, I haven't got a section chief waiting for me at home with a stopwatch in hand to make sure I report in on time. All I have waiting for me at the apartment is a good, cold highball."

Alec grinned: "See you in the morning, doctor."

Troy swung his feet back up onto the desk and went back to the Southern Cal report.

In the parking lot, Alec found his little sport jet and fired up. He eased into the line of cars filing out of the headquarters compound and shot into the stream of homeward-bound traffic on the state expressway. The torrent of vehicles was moving along at an almost steady seventy miles an hour. Alec worked his way into the middle lane since he would be crossing the entire city to reach his apartment complex on the north side. The expressway roar turned into a hollow thunder as it threaded its way for five miles under the high NorCom Thruway that carried high speed traffic across and around the city.

Troy finished reading the prospectus about an hour later and then he, too, left the office. He drove to a small restaurant near Coeur d'Alene for dinner and then, yawning and tired from the night in the mountains and the work of the past two days, headed for his small bachelor apartment on the east side of Spokane.

He watched the vidicast for a half hour and then mixed a nightcap, downed it, bathed and piled into bed. He was sound asleep by 2000.

Across the city, young Jimmy Patterson played with his father, howled and talked his mother out of taking a bath and was put to bed. Alec and Carol curled up on the divan to watch the same show Troy was viewing. At 2030 they, too, were in bed and asleep. The sounds of the city were deadened by the high insulation construction of the building. Possibly half of the nearly three million residents of Greater Spokane were asleep in their beds shortly after midnight, but the other half were either at work or play when the earthquake hit.

There were three distinct and violent temblors, lasting from one to four minutes. The great buildings of the metropolis swayed, glass shattered and fell amidst the screams of frightened thousands. But the city was built to withstand fringe nuclear destruction and the damage was relatively light. The shocks rocked the entire Northwest and were felt from British Columbia as far south as San Francisco and east to Salt Lake City.

In his bachelor apartment, Troy was sprawled on the edge of his bed when the first shock wave struck. The shuddering, stomach-churning wave tossed him to the floor and a picture dropped to smash against the floor.

"What the hell," Troy exclaimed in shocked sleepiness as he tried to get up. The floor continued to sway under him. He got to his hands and knees and fought to orient himself and his thinking about what was happening.

His first thought was an explosion and he staggered toward the window. There was no sign of one. A minute later, the second and lighter tremblor hit and he grabbed for support.

Across the city Alec and Carol sat up wide awake during the last instants of the first jolt. Without a word and with a single mind, they rushed for the other bedroom to seize and comfort the frightened and crying Jimmy. They were clutching him closely when the second shock struck.

"It's a quake," Alec analyzed calmly, "nothing to be frightened about." He, too, walked to the window to see if there were outer signs of damage. When it looked fairly normal, he went back to the bed to help Carol calm the frightened child.

"Mother Nature is just shaking things into place a little," Alec told his son. "It's nothing to fear, old man. Come on, let's go out in the kitchen and get a cup of hot chocolate and then we'll all go back to bed."

Jimmy wiped his eyes and swung his feet over the edge of the bed. "Can I sleep in with you and Mom," he asked.

Alec ruffled the already mussed hair. "Sure you can, big fellow."

They went into the kitchen and Carol began making cocoa. Alex was fishing in the cupboard for the cookie jar when the vidiphone buzzed. He went to the wall and pressed the "Answer" button.

The worried face of Jordan Plumber snapped onto the screen.

"Alec," he said grimly, "get over to the office right away. All hell's broken loose."

"I'll be there as soon as I can dress," Alec said. "What's happened?"

"The quake has cracked the Spokima Reservoir. Right now we've already lost nearly a million acre feet and God only knows how much more is going out. Snap it up." The screen went blank.

Alec turned to Carol. Her face was ashy and she bit on a knuckle to fight for control.

He put an arm around her. "We'll manage it, baby. I've got to go." He turned and hurried from the kitchen to dress. At the door he paused and turned back. "Fill up every possible container you've got empty with water. Right now! Fill the bathtub and half the kitchen sink. Just use the other half for drain. And make every drop count. I don't know how long I'll be gone but I'm sure they'll be cutting the domestic water off any minute now."

Alec heard the wail of sirens in the distance as he climbed into his car. Threading his way onto the expressway, he switched the radio to standard broadcast band.

". . . Is little damage reported," the voice of newscaster said in matter-of-fact tones. "Seismologists at the University of California and Seattle University have placed the epicenter of the quake within fifty miles of Pullman,

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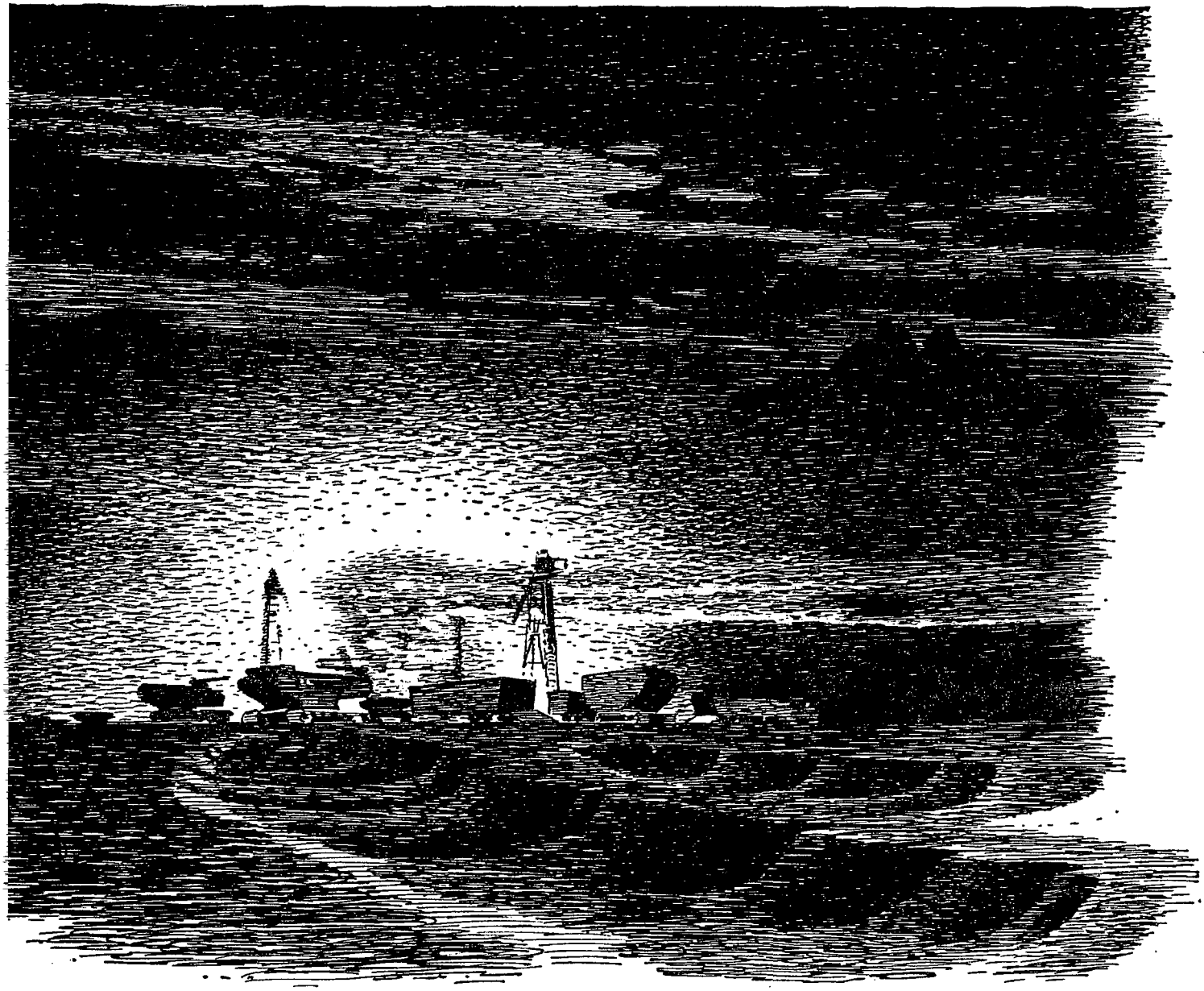

Washington. We repeat, there has been little damage and no reports of personal injury in the Spokane area. However, communications with the Pullman-Moscow, Idaho area have been temporarily disrupted. Early reports from the quake center seem to indicate possibility of heavy damage and possible injuries there. There is no confirmation at this time but stay tuned for details as they . . ." the announcer paused, then continued. "Here is a bulletin just handed me from the Greater Spokane Municipal Authority.

"The quake has caused some minor damage to water mains in some areas of the city. Crews are now being dispatched to the scene to make repairs but in the meanwhile, domestic water supplies are being shut down while the repairs are in progress to conserve water supplies. Only emergency water lines are being maintained for fire and disaster control. The Authority says water service will be resumed shortly and there is no need for alarm."

Alec shut off the radio and concentrated on the traffic. By the time he reached Regional headquarters, traffic flow was already increasing and he caught glimpses of family cars piled high with obviously tossed-in belongings, heading out of the city.

The gate to Region Six headquarters normally stood open twenty-four hours a day. Now it was closed as an armed security guard stopped him. The officer stooped and peered into the car. "Hi, Dr. Patterson, go right in." He waved to another guard on the gate and the portals swung open.

"What's the check for, officer?" Alec asked.

"I don't really know, doctor," the guard replied. "Must be something to do with the quake. All I know is that we got orders to check all persons coming in and not allow anyone in who's not connected with the division." He waved Alec ahead.

Patterson parked his car and walked quickly to Snow Hydrology. He entered the offices to be struck by a bedlam of sound. Men were scurrying from cubicles, hands loaded with papers. Others were talking rapidly to distant vidiphone reporters. Alec skirted around one group huddled over some topographical maps and headed for his office.

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From across the room Plumber spotted him and shouted: "Alec, staff briefing in the conference auditorium in five minutes."

Alec nodded and went into his office. He gathered a notebook from a desk drawer and then walked around the partition and looked in to see if Troy had arrived. Braden's coat was hanging from the back of his chair, but he was not in the office. Notebook in hand, Alec headed down the corridor for the big conference room in the adjacent wing. People from every section in the headquarters were streaming towards the same location and the outer doors along the corridor kept swinging open as latecomers dashed in.

Alec joined the crowd squeezing into the auditorium conference room. Inside, he looked around and spotted Troy against the side wall. He worked his way to his side.

"Hi" Troy said. "How's Carol and Jimmy?"

"They're O.K.," Alec said. "I told her to fill up everything in the house with water and I think she had time to get them filled before the water shut down. How bad is it?"

"It's not good," Troy said. "At this point, I don't think anyone knows just how bad or how good it really is. Spokima ruptured and is spilling but it doesn't appear to be going out too fast. The worst situation seems to be in the Columbia Riverbed System. Unofficially, the grapevine has it that both Moses Lake and McNary tanks have had it and God only knows how many aqueducts have been fractured. We're in deep trouble, buddy."

The babble of voices in the jammed auditorium stilled as the figure of Regional Director James Harbrace and his staff of sectional supervisors came onto the stage.

Harbrace moved quickly to the rostrum microphones.

"I won't waste words or time," he began. "As of ten minutes ago, Regions Five and Six have been on Emergency One Condition. They will remain on Emergency One indefinitely—certainly until we have had a chance to assess full damages to the systems and have made what repairs we can."

Emergency One conditions put all water control for the entire western United States under the direct supervision of Harbrace and his counterpart director in Region Five. It meant all but emergency fire and disaster systems shut off; industrial supplies halted; domestic waters limited to a pint of water per person per day. Since it was midwinter, agricultural waters were not running in the Northwest. But in Region Five, already in short supply, only those crops nearing maturity and having essential food needs for the populace, would be given minimal supplies to bring them to harvest. The later-growing crops were doomed.

"Here's what we know right now," Harbrace turned to an illuminated map of the region and using a light beam indicator, began pointing to the various storage and supply facilities.

"Spokima is leaking at the rate of a quarter million acre feet an hour. We've got sub scanners working the bottom now to survey the crack. The bottom has gone out of Moses Lake and the whole east end of McNary is shot. Hanford has enough water in emergency storage to continue reduced power output for about another seventy-two hours."

The point of light moved east towards the Snake, Clearwater and Kootenai rivers in Idaho.

"All aqueducts leading into the Columbia system have been closed and we can give thanks that this has come in winter rather than in the spring runoff. Even so, we're going to have some flooding problems as the rivers back up.

"We feel that the aqueducts in the Pullman area are probably gone although we haven't verified. Our big problem now is to find out what transfer systems are still functional and start salvaging what we can.

"Secondly, if and when we can make repairs, we've got to get water back into the critical areas and figure some way of storing and valving to keep it functional.

"That's the big picture and it's damned black. Public Information is taking care of the video and radio information. We want to avoid panic if we can and to avoid mass exodus into outlying areas that couldn't possibly cope with the population demands because of the messed-up system. We've got to handle it where we are, keep the people in place and face it here. And by here I mean not only Spokane but Portland, Seattle and all the rest of the major cities. We live or die on this situation. Now let's

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get to work. You'll have detailed instructions from your section leaders in fifteen minutes."

Back at Snow Hydrology, Alec and Troy lighted cigarettes and waited for Plumber to show up with their assignments. Of all of the sections, theirs was the one which would have the least immediate action. The bulk of the emergency was falling on the waterflow and engineering sections.

"Let's go have a look at the profiles," Troy suggested. "This quake could have set off quite a few avalanches."

They went into the survey data room where a half dozen technicians were running bank scans of the gauges throughout the Region. At the desk on a raised dais in the center of the room, the junior duty engineer was poring over a fresh set of graphs.

"How's it look, Walt?" Troy asked. The young engineer looked up at them and smiled. "Hi Troy, Alec. Oh, not too bad from our point of view." He indicated the graphs on his desk. "We've had some shifting in loose pack and ice stratas along the Palouse Range, a little in the Sheep Mountain Range. But so far, we've been lucky. The worst one is right here, on Lookout Peak. She must have dumped at least a hundred thousand tons down the slope and into the valley and she stripped right down to the rock and took out every gauge on the way. Then it piled up in the valley and knocked out all but three gauges there. And they're reading anywhere from sixty-five to more than one hundred foot depths. We'll lose some of that if it's not lying right for retardation spraying."

The three engineers studied the new profiles as they came in from the techs. They were huddled over the desk when Plumber entered the room and joined them at the table.

"What's the word, Jordan?" Alec asked.

"Nothing for us right now," Plumber said. "We're to remain on standby alert, possibly fill-in in other sections for the time being. Then we'll have to come up with some new figures as quickly as possible."

He glanced down at the charts and then asked the duty engineer, "How many positions knocked out?"

"No reports from sixty-eight gauges on this last scan," Walt reported, "most of them in Idaho. But there may be a few more before noon tomorrow. According to my last avalanche report before this thing hit, there should be at least ten more cornices that could have been cracked by this shock but that haven't fallen yet. It's still snowing over most of the Sawtooths but it's due to let up by dawn and a warning trend set in. That ought to trigger the others and when they go then we'll have just about all the replacement figures we'll get. What's the chances for more quakes?"

Plumber shrugged. "Seismology says we can expect settling tremblors for as long as four more weeks and possibly even another sharp jolt. I wish those guys were a little more scientific in their predictions."

Troy hid a grin. "Want us to get ready to head back to the hills, Boss?"

"No," Plumber said, "you two stay put for the moment. You just got back and unless I really need you, I want you here for the moment. I'll get a couple of other teams together to take care of the replacements. For the time being, see what you can come up with in some equations for the Pullman-Moscow potential east of the aqueducts. Break it down, stream by stream for me. I can't tell you which systems are going to be functioning or how we'll be able to divert if needed, so keep the equations at gatehead pressures and flow."

The two engineers nodded and headed back to their offices. Alec punched his home number on the vidiphone and Carol's face appeared on the second ring. "Oh, Alec, I'm so glad you called, honey," she said. "I've been worried sick since I heard the broadcast."

"You get that job done that I told you to do before I left," Alec asked.

"All filled," Carol replied with a smile. "What do we do now, darling?"

"You and Jimmy just stay put," Alec warned. "You've got a pretty good supply of food in the apartment right now. In the morning, go down to the store in the building and see what you can buy in the way of staples and long-storage foods. And get all the juices you can. Don't worry about the money end of it now. Spend it like it was going out of style."

"That bad, Alec?"

"Nothing that can't be handled," he replied, "but it may take a while and it may get awfully dry before it gets wetter. And listen Carol, you and Jimmy are to stay in the apartment and don't let anyone else in. You understand?"

She nodded.

"I don't want you or the boy out on the street under any circumstances. I'll probably be here at the office for at least another day, but if I'm not, then we won't be away for very long. I don't know when I can get home, but I'll call you every chance I get."

"All right Alec," Carol said. "I love you, darling. Do be careful."

Alec smiled and blew her a kiss and then snapped off the connection.

Troy had picked up the latest revised ten-, thirty- and sixty-day meteorology predictions and was beginning to lay them up against the strip segments of the snow profiles from north to south along the length of Region Six. He was engrossed in the problem when Alec stuck his head in the cubicle.

"I'm bugged," the chunky engineer said. "Got a moment to talk?"

Troy shoved the papers back and waved to the chair. "Have a seat doctor and unburden yourself. Relax, let your mind go blank. Tell me about your childhood. Did you hate to take baths? Does the sound of flowing water

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stir subconscious hatreds in you? Dr. Braden will analyze all your problems."

Alec grinned and pulled out a pack of cigarettes and offered one to his partner.

"Now that I think about it," he quipped, "I used to tangle almost every day in fifth grade with a kid that looked just like you. Seriously, Troy, I've got a wild idea and I want to try it out on you before I hit Jordan or The Scourge with it."

Troy leaned back and put his feet on the desk and listened.

"Actually, this is a little out of our line," Alec continued slowly, "but something we did up in the hills day before yesterday brought this on. The idea stems from the way we excavated that gauge, yet it calls for an entirely different idea and technique.

"Now I haven't the slightest idea how bad Spokima is cracked or just where the crack is, but I think there may be a way to recover some of the lost water. And if it works, it might be used on Moses Lake and McNary."

He paused and pulled a pad of scratch paper towards him and brought out a pen to make rough sketches. Troy swung his feet off the desk and leaned forward to watch.

"The idea came to me," Alec said, continuing to sketch, "from the runoff trough you cut to carry off the snow melt from around the hot box. Now just suppose that the crack in the reservoir is along the bottom side, although that doesn't really make much difference . . . yet it might make the operation a little easier since it would concentrate the leak runoff.

"We know the reservoir is set in the bed of the Columbia from the confluence of the Spokane River down to old Grand Coulee. And we know just what the strata formations are both below the reservoir and in the aquifer downstream. That lost water is going into that strata and is going to work its way down the slope of the terrain but it's also going to level off on the first bedrock strata it hits and that's where I think we can stop it.

"If we ran a deep and big enough bore down ahead of the flow and cut a catch basin and then dropped a series of pumps into the basin, I think we could save a lot of that water by getting back onto the surface."

Troy studied the sketch for a minute. "How are you going to sink a bore that fast?"

"Laser," Alec replied simply.

"It would take one hell of a lot of industrial laser units," Troy murmured thoughtfully, "but, if we could get them, it just might work. What do we do if we can get the water back to the surface?"

"Same story," Alec pointed out. "If we can get the bores down behind the old Grand Coulee Dam, then we cut a channel and drain it into the old surface reservoir. Oh sure, we'll lose some surface evap until we can get it back down underground again. But that would still be one helluva lot better than letting millions of acre feet just seep out to sea. And if we had to, we could use the lasers to cut a channel around Grand Coulee and let it run down to the Okanogan where it would go into the Lake Chelan reservoir."

Ten minutes later, Plumber and the two juniors were closeted with Supervisor Wilson, going over Alec's plan. When Alec was through talking, Wilson flipped a switch on his desk intercom. "Harbrace here," the speaker sounded.

"Jim," Wilson said, "this is Morley. A couple of my harebrained kids have come up with an idea that makes sense and looks like it might salvage a lot of lost water. But we've got to move on it right now if it's going to work."

"Get them over here," Harbrace snapped.

Six hours later, the first light of the cold winter morning began competing with the batteries of floodlight tubes banked around a rocky, gravel-based site in the dry bed of the Spokane River. More than three hundred men had been thrown into the experimental project and for three hours a steady stream of huge cargo carriers and aircraft had been piling equipment around the site. A cluster of men stood around a compact pole-beam laser unit aimed at the ground. Upstream a line of metal poles extended up from the dry river bottom for a mile.

"This should be the last one," Alec said. "Let 'er go."

The laser operator fired and the light beam shot down into the earth, burning a narrow hole. "We'll set this one at one hundred and ten feet," Alec told the operator. The man nodded and turned back to his control panel. Two minutes later another metal pole was dropped into the hole. Projecting from the bottom of the pole were several soil moisture detectors. Extensions were coupled on section by section as the electrodes dropped down into the hole. A dozen of the eight-foot sections went down with the last section projecting from the river bed. A technician slapped a meter box onto the connections. "Dry here," he reported.

Alec, Troy and Harbrace, together with Wilson and a half dozen engineers from research and hydraulics and two laser engineers, consulted substrata profile readings.

"Well, if this scheme is going to work," the senior hydraulics man said, "this is the place to try it. We're still ahead of the seepage but not for very long. We've got a good quarter-mile of deep rock for the sump hole. Let's try it." Harbrace nodded in assent and the group dispersed to the side of the dry river bed. Alec and Troy trudged up the shallow slope to a mess truck sitting on the flat. "Nothing we can do now but pray," Alec muttered. They picked up cups of hot coffee and walked back to the bank to watch the operations.

The light laser unit had been moved out and ten huge crawler cargo carriers with vans were being moved into a wide circle around the last soil moisture stake. Crews were unshipping the beam heads of the giant industrial laser guns and making power connections to the series of mobile power reactors that had been set up on the riverbank.

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When all of the units were in place and connected, the crews pulled out. At a safe distance from the bore site, a master control panel had been jury-rigged to control all units simultaneously. Two programmers and a pair of operators sat behind shields while the senior hydro engineer took a place between them and focused on his remote video eye at the site. A quarter of a mile away, vehicles still moved up with new equipment, but the remaining vehicles and other gear had been pulled back from the river bed to the bank.

The hydraulics chief looked around at Harbrace and waited. "Let's try it," the director ordered.

"Three seconds at a time," the engineer ordered. The programmers checked the timer cutoffs for a final time. "Ready?" The operators nod

"Fire," the engineer yelled.

Ten massively concentrated beams of high intensity light waves slammed into the gravel bed. The earth shook and a great cloud of dust arose from the site, momentarily hiding the laser units. A light morning breeze drifted the dust downstream in a minute.

Ten huge holes gaped in the river bed underneath the laser beam heads mounted on adjustable cranes out and away from their power units.

"Fire," came the order again. This time there was nothing but the trembling of the earth as the beams cut a molten path through rock, clay, sand and boulders.

"Measure," the engineer ordered. A radar gauge bounced a beam off the bottom of one of the holes. "Eighty-seven feet," the technician called out.

"Change to a two-second shot." The programmers changed timing.

"Fire and measure."

"One hundred and seventeen feet," the tech called out.

"That's it," the engineer ordered. "Core it out."

Twenty minutes later, a hundred-foot wide bore extended down to bed rock. While the lasers were coring out the hole, six cargo cranes on their 400-ton carrier chassis had been moved into position. Now the cranes hooked onto three of the lasers, two cranes to each unit. Minutes later, the light beam units were dangling over the edge of the vertical bore and then were lowered to the bottom. Additional video monitors together with portable lights followed them down into the hole. The lasers were aimed upstream and began burning a fan-shaped cut into the solid rock. The other three lasers were lowered down to join them and the great catch basin began to take shape.

If the geological survey was correct, the basin would be a good ten feet below the water-bearing gravel strata that should be carrying the bulk of the lost waters from the ruptured underground Spokima Reservoir fifteen miles upstream. The river bed lay in a slight natural fault and the waters should follow beneath the old river bed without too much side loss.

In a half hour the six units had carved out a cavern in the solid rock fifty feet high and extending six hundred feet upstream from the vertical bore. The engineers divided the units, three to a side and began widening to each side of the old stream bed and then working back down towards the surface bore.

While the work was going on beneath the ground, technicians maintained a constant monitoring of the moisture gauges upstream. The first of the four huge, sealed nuclear sump pumps had just touched the floor of the basin at the vertical bore when the tech at the gauge farthest upstream yelped, "It's wet!"

Harbrace and the hydro engineer jumped for the communications phone.

"How deep is it?" the engineer snapped.

"Forty-two feet," came the reply, "now it's forty-seven. Moisture content increasing. This is the head and it's coming fast."

"Get those lasers outta there," the engineer roared, "and get those other pumps down, fast."

More cranes were clustered around the great hole and the three other pumps went quickly to the bottom. Down in the cavernous basin, the lasers rolled quickly back to the bore hole where crews slammed magnaclamps on them and lofted them to the surface.

By the time they were starting to rise, three more closer gauges were reporting underground water flow.

As soon as the first two lasers reached the surface and were swung onto the gravel bed, they were sent waddling on their tracked carriers a hundred feet upstream beyond the upper end of the underground emergency cavern. The beams were set on angle and seconds later the light lanced out and down into the earth, smashing down through the strata and punching two great holes into the roof of the upper end of the cavern. Clouds of superheated steam gushed out of the twin punctures as the beams shut off. The beams had burned through the head of the seeping waters. Now the other four lasers were on the line and in rapid order, a dozen more holes were punched down through the bed and into the catch basin. The upstream roof of the cavern fell in for forty feet and a torrent of mud cascaded into the basin.

The instant the last beam closed down a roar arose from the workers clustered about the lip of the vertical pump bore. A wall of water came surging down from the upstream end of the cavern and smashed into the bore hole wall in a muddy, seething maelstrom. The strata-borne waters had found the hole and were pouring down into the cavern and catch basin. The water began rising in the walls of the hole, sealed into a shining shaft of fused rock and silicon by the laser beams.

"It works," Troy yelled, pounding his partner on the back, "you harebrained son of an engineer, it works."

Alec's face was wreathed in smiles as the two of them hurried down the bank to the edge of the bore. By the time they reached the lip, the water level had risen past the underground upstream mouth of the catch basin and was boiling steadily upwards past the sixty-foot mark

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towards the surface. Despite the vent holes and the volume of water seeping through the strata from the ruptured Spokima Reservoir, there still wasn't enough pressure to raise the water level much above the fifty-foot mark, once the catch basin filled. That was the purpose of the four nuclear pumps in the sump hole. Their great million-gallon-a-minute jets forced the bore hole water up to the surface and kept sucking up the waters cascading now into the cavern.

"Get back," Harbrace yelled at the men still near the edge of the hole. "When it comes over it's going to blow and backwater."

Troy and Alec joined the workmen and technicians hurrying back to the safety of the riverbank. Two minutes later a deep-throated gurgle echoed in the cold morning air and huge bubble, then a geyser of water shot up into the air in a cloud of moisture and vapor spray. It fell back to the dry river bed, spread once again upon the gravel that had known only the gentle touch of rainfall for three-quarters of a century and then boiled and roiled in a gathering head downstream rolling loose boulders and logs in its teeth.

The water level in the river bed continued to rise and a backwater began forming, extending nearly a quarter of a mile upstream before it stopped. Now the bore hole was visible only as a muddy boil of turbulence churning in the center of the newly-flowing river.

The regional director came over to Troy and Alec and slapped the pair on the back. "You two have done a terrific thing here," he said with a broad smile.

"Not me," Troy protested. "This was all Alec's idea. I never thought the thing would work."

"Where's the water going?" Alec asked.

Harbrace pointed downriver to the hidden wall of the old Grand Coulee Dam around the curve in the river bed. "We're dumping into Grand Coulee until we can get it back underground, probably into Chelan. Meanwhile, we're going to see if your idea can be used at Moses Lake and McNary."

The great convoy of equipment and men was already on the move to join the other task forces of similar equipment already on site at the two other major damage locations.

"Nothing more for us to do here now, and the hydraulics people can take it from here," Harbrace said. "I'm heading back to Spokane. You two want to ride back with me?"

They turned and walked toward's Harbrace's personal copter waiting beside the road a couple of hundred yards away.

Without warning, the earth began to shift beneath their feet and the trio staggered on the rolling surface. From deep within the ground came a brief but ominous rumble. Harbrace stumbled and would have fallen as the ground shook had not the two younger men caught him. The shock was over in less than a minute.

"My God," Harbrace breathed, "not again."

He spun and looked towards the river. A wash of waves from the flowing current lapped against the bank but from the center of the stream the waters continued to boil. All three men silently watched for a full minute. From the south where the tail of the convoy was still visible, a light survey car came racing back down the road towards the river.

It slid to a halt beside the bank and Hall, the senior hydro engineer, leaped out and came running towards the director and the two junior engineers.

"Is it still pumping?" he panted anxiously as he surveyed the waters.

The four men eyed the boil for another half minute. Now it was just a churning pool in the middle of the waters, no longer bubbling higher than the surface of the waters. "It's still pumping," Hall muttered, "but something's wrong."

He jumped for his car and grabbed the radio. "Swenson, Baker," he called, "hold it up. Get that pump-monitoring rig back here on the double. And get the rest of that gear turned around and headed back this way. We've got more trouble."

The other three men had walked to the survey car. "What do you think's wrong," Harbrace asked.

"I dunno," the hydro engineer said. "Maybe the shock triggered the pile dampers on one of the pumps. Maybe something else." He squinted at the barely churning waters over the bore hole. "Can't say until we get a monitor on those pumps. If it's just a malfunction in one of the units, I can dump another one down there. If it's something else, we'll have to see then. One thing's sure, they aren't all pumping."

The pump section vehicles had been hauled out of the convoy and were already pulling up along the riverbank before the rest of the convoy of heavy equipment was turned around.

In the big monitor van, technicians already were running remote checks on the underwater pumps. The engineers and the director climbed into the van to wait the word.

"Number One's O.K.," the section chief reported, "so's Number Two." The three technicians at the monitor panel punched and re-punched banks of buttons and switches and watched the patterns on oscilloscopes.

"Something sour on Number Three," the chief said. "Can't say what yet."

"Skip over to Four," Hall ordered. "Let's see if that's O.K., then you can go back to Three."

In two minutes Number Four had been checked out in working order. The analysis concentrated back to Number Three pump.

"I'm getting a steady pile reading," the board man reported, "as a matter of fact, it's running a little hot. But no response to damping effect. She's running wide open."

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"Yeah," the section chief muttered as his eyes shifted along the array of 'scopes on the panel, "I see that, but why aren't we getting any head pressure?"

The board men continued to run new series of response checks on the rest of the pump system. Outside, the head of the heavy equipment convoy came to a halt and the crews climbed out to wait beside their vehicles.

Five minutes later the board men finished their checks and then conferred briefly with the section chief. He came over to the engineers.

"I think we've got your answer," he said glumly, "but I don't think you're going to like it. The best we can figure out is that the shock must have created some kind of a lag turbulence down there and when it was over the water piled into Number Four and slammed it over on its side. Or maybe the shock just tipped it over. In any case, it's either clogged the intake or jammed the nozzles. We don't know which. And it's jammed the dampers."

"So," the hydraulics chief shrugged, "we put another unit down there."

"It's not that simple, Mr. Hall," the monitor chief continued. "That pile's running wide open and no place to go. It's got to be stopped or she'll blow right outta there. And if Four goes—blooey, there go the other three."

The chief engineer sagged. "No chance of getting the dampers to respond?"

The monitor man shook his head sadly.

Hall ran his hand tiredly over his face and stared silently at the flickering oscilloscopes as if to force the damping device into functioning by sheer will power.

He sighed and straightened up. "All right," he said, "how do we shut it off. Is there an outer manual system?"

"There is," the monitor chief replied, "but in all likelihood it's jammed, too, by the shock or tip-over—and I'm more inclined to buy the tip-over than anything else."

"Any other way to shut it down?" Hall queried.

"Just one," the chief said. "Blow her apart chemically before she goes critical. And that, chief, is a real tough one. Someone's got to go down there and clamp some plastic blocks in the right place on the pile housing. Even then, there's the chance that she might blow in the wrong direction and the whole shebang will go up in a big, fat mushroom cloud."

Hall's eyes saddened. "If that's it," he sighed, "that's the way it has to be. Let's get with it. Where does the plastic go?"

"Better check that out with Barton in the main rig," the monitor chief replied. "He's got the prints and he can show you the exact spot on one of the spare pumps. Oh, and Mr. Hall," he paused, "you'd better hurry it up. She's

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leaking a little of the pressure down there but not nearly enough. I'd make a quick guess and say that we've got less than two hours to either shut that pile down or relieve the pressure. And if she's tipped, the time in getting it back up and checking out damage on the pump system is going to take too long and it might not be repairable. The best bet is to blow her."

Hall nodded and with Harbrace and the junior engineers in his wake went to the central pump section vehicle.

Walking to the other vehicle, Alec looked at the water with stricken eyes. "God in Heaven," he said aloud, "I never thought it would end this way."

Harbrace broke stride and took Patterson gently by the arm.

"None of us did, Alec," he said. "This isn't your fault. You had a fine idea and it worked. What happened afterwards is no worse than the original quake that caused the damage. If this thing blows out, we won't be out any more water than we would have been if you hadn't come up with the idea in the first place."

"That's not what I meant," Alec said in a shaken voice. "If this does blow out, not only do we lose the water but we're going to contaminate this aquifer with radioactivity from here to the mouth of the Columbia."

"I know that, too," Harbrace replied softly. "It's still not your fault, son. And we're not licked yet. Come on."

Twenty minutes later, a double strand of durasteel cable stretched across the three-hundred-foot wide current, suspended between the raised crane towers of four of the mammoth crane carriers and passing twenty feet above the churn of the bore hole.

Hall and a half dozen of his section chiefs stood at the base of one of the makeshift towers. The chief hydraulic engineer had a headset clamped on for contact with all the working units.

He turned to one of the men standing by. "Get me a pressure reading on that hole," he ordered. "I want to know how much weight it's going to take to get down through that mess."

"Why not just shut the other three down while we go down into the hole?" the assistant asked.

"Calculated risk," Hall said. "If she's going to blow, it isn't going to make any difference if the others are shut down or not. And, if we can keep pumping while we're working, we're staying ahead of the flow from the reservoir. Get me that reading."

The pressure report was back in minutes. "It'll take at least a four-ton mass to get down there fast and keep from being bucked around.

Hall looked around, "What have we got that's small enough and has that weight or better?"

"How about a van tractor?" one of the supervisors suggested. "They weigh closer to six tons but they're pretty compact."

"Fine," Hall snapped. "Rig it."

The bulky, almost square, tractor was rolled up and the rigging crews were swarming over it, clamping suspension cables from the running pulley that would ride the cable across the current.

"What's the radiation report?" Hall asked monitoring.

"Still building," came the reply. "But we've got a leak somewhere, Mr. Hall. We're getting readings from the water down there. Not too much yet, but it may change our time factor. I'd either get on it fast, chief, or let's get outta here. That thing can go any minute now."

The tractor was rigged. Hall turned and bawled. "Where are those divers?"

Alec Patterson and Troy Braden stepped out of a nearby van, dressed in pressure suits and tanks, their helmet flaps open. Alec had a heavy belt of ultra-high explosive plastic lashed around his midsection. Troy carried a rack of small clamps strung across his shoulders.

"Where do you think you two are going?" Hall roared. "Get those suits off and get outta here."

"Shut up and listen," Alec snarled. "I started this. I'll finish it. This idiot partner of mine hasn't got any better sense than to go along. We haven't time to argue, so just listen.

"Both of us have been trained in hydrology and have made many dives before. We've both used this plastic and we've both handled hot stuff, probably more than any of your people. Your man has checked us out on the pump assembly and we know just what we're looking for. Let's go."

Hall glared at the pair for a second and then whirled to the rigged tractor. "Get that canopy off that thing," he ordered. "They can ride it down in the seat."

He turned back to the junior engineers. "Got lights?" They both indicated a pair of sealed handbeams on their belts. "All right, get aboard."

"Casey," Hall called over the intercom, "got that communications line rigged?"

"All set, boss," came the answer. "It will run out the cable and down the cab. I've left them plenty of slack to move around when they get down there."

"O.K.," Hall waved to the riggers, "everybody get outta here. Casey, plug them in."

Alec and Troy had entered the cab. The communications man leaned over and coupled the phone system into their helmets and then waved at Hall.

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"You two hear me?" Hall demanded.

"Loud and clear," Alec replied.

"All right," Hall ordered, "let's get with it. This is a general order. All vehicles and personnel not directly involved pull back a full mile."

Men and equipment began moving away.

"O.K., Number One crane, lift 'em."

The crane operator on the near bank eased his gears into motion and the six-ton tractor lifted into the air with Alec and Troy aboard. When it was five feet above the ground, the crane on the opposite shore began hauling the draw line and the vehicle swung out over the water.

"Now listen closely," Hall ordered the pair in the swinging vehicle, "from this point on, you are in control. Stop your slide over the hole by just yelling 'Stop.' Number One crane is your up and down operator and also will pull you towards this bank. If you need to go forward or backwards when you get inside the hole, just say which way and both crane carriers will move in the direction you want. Got it?"

"Affirmative," Alec replied.

A second later he yelled "Stop." The pull halted and the heavy vehicle swayed just a foot above the churn in the waters. Alec waited a minute until the tractor quit swinging and then ordered, "Let's go down."

Number One crane began paying out cable and the tractor and men slipped beneath the surface of the turbulent waters.

Surging, silt-laden water rushed upwards past the sides of the heavy cab and swirled around Troy and Alec. Both were clamped into the seat by a steel mesh belt and the waters tore and whipped at them. Despite the six-ton mass of the tractor, both men could feel it quiver against the thrust of the waters rushing and breaking against its undersurfaces. Although both had turned on their powerful suit lights, the lamps made only a dim glow in the surging waters. When the tractor had dropped some thirty feet, it was Troy who yelled "Hold it!"

The downward motion stopped.

"Let's get back against the wall," Troy yelled over the roar of the torrent. "Those pumps are pretty well to the center of the bore and I don't want to come down on top of one of them, even the bad one. Move back!"

On shore, both cranes began inching up stream.

In the thundering bore, the tractor bumped against the wall of the hole. "Hold it," Troy shouted. The carriers stopped. "Take 'er down."

Again the massive vehicle descended into the depths. The roaring became louder with every foot and the constantly dinning noise rattled the earphones of the crane and carrier operators. Hall stood on the bank, his eyes glued to the thread of cable vanishing beneath the waters.

The tractor was bumping against the wall with more violence and the engineers could feel it tip and sway as the turbulence increased from below.

"I think we're too close to Number Two pump," Alec yelled. "Let's get a little more offshore." On the far bank, Number Two crane began hauling the pulley towards him.

The undersurface bobbing lessened. "That's good, Number Two," Alec shouted. The downward motion continued.

As suddenly as it began, the turbulence almost ceased and the sound diminished in the black, watery hole. The big nuclear pumps stood thirty feet high with their great jets at the top. The tractor had descended below the level of the jet thrust. At the same instant, there was a forward motion and the tractor began to sweep towards the downstream wall of the bore.

"Drop us, fast," Alec commanded. "We're being sucked."

Number One crane operator slammed his release button and the tractor fell with a jarring crash to the floor of the catch basin. On the floor, its mass held it in place against the drag of the three huge pumps and the natural flow of the water.

The water was clearer and their lights penetrated a few feet into the black-green hell around them.

"You see it?" Alec asked his partner.

"Not a thing," Troy replied, "but we can't be more than a few feet from it. It's got to be somewhere in front of us and I think a little to my side. The suction drag doesn't seem quite so heavy over here."

"Number One," Alec instructed, "give us a fast one-foot lift and drop it immediately. The current will move us."

The operator took up the slack in the cable and then gave a short burst of upwards pull and slammed the release. The tractor lifted and was carried forward about five feet before it slammed down again and stopped.

"There it is," Troy yelled, aiming his light to the right front of the tractor. The beam picked out the massive casing of Number Four pump. "Let's get in closer." On instructions from the submerged engineers both cranes lifted and hauled briefly. The tractor slammed into the bulk of the disabled pump. Troy and Alec played their lights over the plate.

"This is the bottom plate," Alec said. "It's tipped all right. Got to ease around to one side."

Again the cranes dragged and lifted and the massive tractor scraped along the bottom plate of the overturned pump. Suddenly the vehicle whipped forward. "Drop it," Troy yelled, and the carrier smashed to the basin floor.

They were alongside the main outlet tube, now tilted downwards on an angle towards the floor of the basin. Below them and under the curvature of the tube was the pile housing. The explosive had to be placed at the point where the pile housing, the pump base and the outlet tube met.

Currents of water still swirled around them and tugged at the two men. But it had much less force than during the downward descent. Alec unclamped the seat belt, then slammed his magnetic clamp suit boots against the outer plates of the carrier. His suit buoyancy dragged him into

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an awkward crouching position and he swayed and fought against both the upwards lift and the current swirl.

"Let's go," he said.

A hundred and seventeen feet above them, Hall and the crane operators could hear the hollow clang of the magneboots as the two engineers inched their way back alongside the tractor to a spot where the tractor hull touched the pump housing. Alec cut one foot loose from the vertical side of the tractor and slammed it against the pump base and then quickly shifted the other foot and began forcing his way down under the curve of the tube. Troy followed.

In the shelter of the base and tube, the current no longer pulled at them and it was only the suit buoyancy to battle. It took them three minutes to struggle their way to the juncture point. Alec wedged himself in with his back against the housing above him and carefully began unwinding the explosive belt he was wearing.

With his feet clamped on the vertical wall of the pump housing and knees locked in a skier's stance, Troy handed over the first of the magnetic clamps. Alec took it and carefully clamped the end of the plastic explosive belt against the pile housing. They worked slowly but steadily until the entire band of explosive was in place along a five-foot arc of the housing.

During the entire operation, neither man spoke and on shore, the listeners could hear only the heavy breathing of the pair and an occasional muffled sound of a clamp going into place.

When the plastic was locked down, Troy carefully unclipped a timer fused from his belt and handed it across. He spoke for the first time since they left the tractor. "It's set for seven minutes." In the wavering light of the murky waters, he saw Alec glance up at him and then gingerly insert the fuse into the explosive.

"Get moving," Alec ordered. Troy started inching his way back along the pump housing wall. Alec waited until Troy moved into the gloom and almost out of sight, then flipped the water-tight switch that activated the fuse. The device was armed. In seven minutes, if the pile didn't go critical before then, the charge would detonate—whether they were back on the surface or not.

He shoved himself free of the pile housing and followed Troy back along the wall of the base. At the hull of the tractor, he made the foot-at-a-time crossover and again fought suit and current to get back to the cab. The seconds ticked off into the first minute and into the second. Ahead, Troy had reached the aperture of the cab door and reached in to grasp the end of the steel safety belt. He hauled himself into the seat and looked back for Alec.

The other engineer had just reached the cab. He swung a leg over the sill and at that moment, a surge of current whipped his suit. He twisted, grabbed for a handhold and missed and shot up towards the surface. In that same instant, Troy shot up out of the seat, holding the end of the belt in one hand and grabbing for Alec's ankle with the other. He caught it and clutched. "Up, fast," he screamed.

The tractor snapped up under them and threw both men against the seat. Alec seized a control handle and hauled himself into the seat as the vehicle surged upwards. Under full power, it was whipping towards the surface and now, the water pressure was holding them down. The timer passed the four-minute mark when the six-ton carrier burst out of the water in a geyser of spray. The cable whipped and almost threw them from the cab. Then there was a spine-snapping side jerk as the Number One crane operator began smoking the cable pulling them to the shore.

Thirty seconds later the tractor slammed to the ground. Hall and the crane carrier driver were waiting. They reached in and jerked the two engineers from the seat and half carried them to the rear of the massive crane carrier. The operator had already leaped from his cab and was lying prone, face down on the ground.

Troy and Alec, together with Hall and the driver, stretched out alongside each other in the dubious shelter of the carrier and waited.

The seconds ticked off. A minute later, a small geyser of water shot up a few feet from the surface of the water and seconds later they heard a slight rumble. Then there was only the sound of their breathing and the rush of water in the river.

Hall jumped up first while the others were still scrambling to their feet. He raced to the radio after a hasty look at the river.

"Monitor," he called, "what's the story?"

"They got it, boss," monitor answered. "The pile is dead. You've got some hot material in the water but it's dissipating fast. All other pumps in good order."

Hall broke into a big smile. He walked back to where Troy and Alec were struggling out of their pressure suits.

In the distance, the director's copter was lifting from the ground and heading towards the riverbank. A few minutes later, while a new pump was being lowered into the bore hole, the copter took off en route to Spokane. The two junior engineers were aboard. When it landed at Region Six heliport, Alec jumped from the ramp and ran to the nearest building. He found a vidiphone and called home.

Carol's worried face appeared and then lighted when she saw her husband.

"Honey," Alec said, "you can go ahead and bathe the kid now."

He came out of the building to find Troy waiting. They grinned at each other. At that moment, Supervisor Morley Wilson came hurrying by.

"All right you two," he snarled, "so you've solved one little problem. Remember, you've got just nine days left to give me an answer on those new production units." He hurried away.

Troy gazed at Wilson's departing back.

"That's what I like about working for DivAg," he murmured. "Nothing ever changes." ■

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AM I STILL THERE?

Which must in essence, of course, simply be the question "What do I mean by 'I'?" by **JAMES R. HALL**

ILLUSTRATED BY LEO SUMMERS

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Lee slid off the examining table and began buttoning his shirt. He had had a medical examination every six months of his adult life, and it always seemed strange to him that, despite the banks of machines the doctors had which could practically map a man from a single cell outward, each examination always entailed the cold end of a stethoscope against his chest.

He tucked his shirt into his pants and turned to the examining doctor who was writing on a chart.

"Well?" Lee asked him.

"Sound as a dollar," replied the doctor. "Of course Dr. Flotman or Dr. Roberts might turn up something on their electronic monsters, but I see no reason why we can't go ahead on schedule."

Lee felt relieved. Even while being examined by technicians, M.D.'s and biologists, he had been conscious of the hundreds of little dull pains which had nibbled like mice in every corner of his brain. Sometimes he felt like a piece of his brain was being completely smothered, a horrble sensation of having a part of his head severed from him. This would go away, but would appear again in a different area, usually in about fifteen to thirty minutes. Well, the doctor said he was fit for surgery. That would end this nagging pain, just as it always had in the past.

". . . If you're ready now." Lee became aware the doctor was speaking to him.

"Oh," Lee said. He had no idea what the doctor was talking about. "I'm sorry, I guess I didn't hear what you said—"

The doctor smiled tolerantly. "I said you can see Dr. Letzmiller this afternoon to get the final O.K."

"Letzmiller? Who's he? I thought you said I was ready to go." Lee knew he sounded a little petulant, but he was tired from all these examinations, and besides, his head hurt.

The doctor, Gorss, Lee thought his name was, was rather young but seemed used to this kind of thing. He turned on his tolerant smile again. "Dr. Letzmiller is chief of the Familiarization and Post-Operatve Adjustment Section. He can explain himself better when you see him."

"Is he the last one?" Lee asked. He was already following Dr. Gorss out the door and down a corridor.

Dr. Gorss stopped before a door marked "Dr. C. L. Letzmiller," and opened it. "The last one. You take these," he handed Lee a thick manila folder, "and tell the girl Dr. Gorss sent you for your interview." He waited until Lee had entered, then closed the door and left.

Evidently Dr. Letzmiller had been expecting him, for very shortly Lee found himself sitting at the doctor's desk, comfortably seated in a brown leather armchair. He was facing a rather pudgy man, who was leafing through the manila folder Lee had given him. Finally Dr. Letzmiller looked up.

"Well. Well now, Mr. Lee, suppose you first tell me about yourself, and then I'll tell you about me."

"Tell you about me?" Lee asked.

Dr. Letzmiller smiled. It was another tolerant smile, but it seemed more sincere than Gorss'. "I suppose the best way would be for me to review these facts on your medical history. You are Vincent Bonard Lee?"

"Yes, sir."

"Date of birth?"

"August 11, 1934."

"That would make you four hundred nine years old."

Lee hesitated. He never really thought of his age. It had long ago ceased to be of any importance to him. Of course he remembered his birth date. It was one of those facts that always appears on your records, like your social security number. He did some calculation in his head, as rapidly as the constantly shifting blank spots in his thinking would allow him.

"Yes, sir."

"It shows here that you first underwent replacive surgery in 1991. Correct?"

"Yes."

"Remember what it was for?"

"Yes, I had heart trouble. They fixed me up with one of those big jobs requiring my carrying batteries under my armpit."

"One of those early models. And this shows that at various times since then you have undergone replacive surgery some eighty-seven times, including three replacements of a pulmonary nature."

Again Lee hesitated. The number of times he had had a worn organ or tissue repaired or replaced was more than a little hazy. After the novelty of the first few times when he found himself with a new stomach, or liver, or muscle, he had started to take these things as a matter of course. He gave a little nervous laugh. "If that paper says so, I suppose so, doctor."

"Yes. Well, everything seems to be functioning properly now, doesn't it? With the exception of your head, of course."

"Yes, yes I feel fine otherwise." Lee was feeling uncomfortable. "Doctor, could you tell me what this is all about? I must have answered these questions half a dozen times before to those other people."

"In just a moment. First I need to know you a little better. Your medical history lists your occupation as 'cabinet maker'."

"That's right." Lee was becoming more and more uncomfortable. The extensive examinations had tired him, and repetition of the answers to all these questions was making him edgy.

"Doctor, can't you at least tell me what type operation I'm going to have?"

"What do you think it will be?"

"I don't know. Some sort of repair on my head, I guess."

"Mr. Lee, this isn't going to be a matter of repair. We have found it necessary to replace the entirety of what

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could roughly be called your 'brain', as well as part of the spinal cord."

"My whole brain?" Lee, sat, stunned, comprehension slowly filtering into him. He voiced the only coherent thought which materialized. "Why that will mean there won't be anything left of me at all."

Dr. Letzmiller regarded him. "What do you mean?"

"Doc, you've got my records there. At one time or another, since they first put a new heart in me, every single inch of me has been replaced by an artificial part. I mean all of me. There's not one bit of me, heart, eyes, toenails, *nothing*, that is *me*. That bothered me quite a bit when this left eye was put in. I mean I thought, 'Well, this isn't me. This is my brain walking around in a jumble of artificial flesh.' I tell you it bothered me. But I went to a doctor, you know, a psychoanalyst, and he convinced me that as long as I had what he called a 'sense of identity', that I was me." Lee stopped. How could he explain it?

But Letzmiller seemed to understand. "And you think that your brain is all that is left of 'you'?"

"Doc, it's a funny feeling. Like this." Lee raised his hands, brought them together and touched his fingertips. "See that? I can raise those hands. I can make them touch each other. I can feel them touching each other. But it is just not quite right. It's just a little bit off key, like one trumpet player out of twenty being about one-sixteenth of a note flat. Know what I mean?"

"I think I do," said Letzmiller, nodding slowly. "Now, just what does that have to do with your operation?"

"Doctor—" Lee had to stop, for the patchwork quilt of blank spaces was dancing in his head. The helplessness went away, slowly, like smoke drifting from a fire. As his mind cleared, he realized that he didn't know why he was being interviewed by this doctor.

"Anything wrong?" Dr. Letzmiller asked.

Lee knew he wasn't being too coherent, jumping about with the conversation this way, but he asked the question, anyway. "Doc, why am I seeing you?"

"You haven't guessed?"

"No."

The doctor paused to light a half-gone cigar. "My job here at Merkins Replacive is to deal with just such fears as you have expressed. I'm an M.D. and a psychologist, and"—Letzmiller smiled to himself—"a kind of historian."

"Historian?"

"Well, you see I was supposed to give you the regular formal lecture on the history of replacive surgery when you first came in. Like to hear it?"

Lee nodded, so Letzmiller continued. "Replacive surgery is actually quite old. Old as medicine itself, I suppose. Very early attempts at dentures were tried, though with little success. And, of course, peg legs and hooks for persons who had lost their hands might be called replacive surgery, though they were very crude. Later on came more refined dentures, artificial limbs, corrective lenses, skull plates, hearing aids, plastic or cosmetic surgery, blood transfusions all types of skin grafts, et cetera.

"The 1950s saw the beginning of bone and corneal transplants, use of plastics in arteries, those huge heart-lung and kidney machines, implantation of electrodes in the heart to steady its beat—many things which were mostly emergency or stop-gap measures. All through the late 1900s refinements continued to be made, but it wasn't until 1988 that the fathers of replacive surgery, Doctors Mills, Levinson and McCarty made the breakthrough that revolutionized the whole concept. In very simplified language they unlocked the key to producing specialized living tissue through a bombardment of an extremely complex carbon compound with amino acids and electricity, then making it selective in function by a fantastically intricate application of radiation.

"That pulmonary replacement you received in 1991 was undoubtedly one of the first successes. You were quite lucky, you know. Up until 2017, only about five per cent of their synthesized hearts lasted more than thirty days. At any rate, the principle was established, and it was proven that it could work. Most of our work from then till a few years ago has been in improving and refining the work those three good doctors did over three hundred years ago."

Letzmiller's cigar had gone out, and he discarded it in favor of a cigarette. "That would be the end of my history lecture, if it were not for the nature of your trouble."

Lee looked at him closely. "Why's that?"

"Well, Mr. Lee, the big thing missing in that summation is the seemingly impossible task of synthesizing nerve tissue, especially that of the cerebral cortex. It's been approximated, at any rate closely enough to give us good enough results to allow an artificial tissue to respond to brain signals about ninety-eight per cent as well as the original would. But actual duplication? No. At least not until about three years ago. To tell you the truth, it is barely out of the experimental stage."

"Experimental!"

"Yes, this will be the first complete replacement of a human brain. Oh, of course it has been done with animals, and it has been successful with partial replacements on humans. But you will have the honor of being the first human with a complete substitution."

Lee could not contain himself. "Doc, that's just it! There won't be a single atom of me except what you fellows have conjured up—"

Letzmiller broke in mildly. "I think 'conjured' is hardly the proper word, Mr. Lee."

"Well, of course, I didn't mean that. But don't you see what I'm driving at? You could just as well start from scratch and duplicate me without bothering about going about it piecemeal. And what does that make me?"

The doctor had been looking at Lee intently, studying him through this outburst. "I think I see what you mean. And I can't answer you. The question you raise may be philosophical, or metaphysical, but it certainly isn't medical. And from a doctor's point of view complete sub-

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stitution is the only course open, risky as it may seem."

Lee mulled this over. Of course he knew surgery was the only solution to his decaying mentality, actually the only alternatve to his becoming a virtual idiot, and, shortly after that, dead. And he did not want to die. He *had* lived a long time, but thanks to the methods of Letzmiller, Gorss, and all their predecessors, he was as full of juice as he had been at thirty-five. But the question that kept plaguing him Letzmiller seemed determined to avoid. He didn't understand very much about replacive surgery, really didn't care to. If Letzmiller said it could work, then he wasn't worried about that. Well, he guessed he really didn't have much choice. With this realization, he had only one more question for Letzmiller.

"Doc, if I'm not me when this is over, do you think I'll know it?"

Letzmiller looked at Lee's troubled face. "Do you think that you would want to?"

Lee answered slowly. "No, no I guess not."

Letzmiller rose from his chair. "I'll talk to you again after the operation. Do you think you're ready to go to your room now?"

Lee nodded and obediently followed the doctor.

Lee was asleep when the nurse came, but with the efficiency of all good nurses since time immemorial, she woke him to give him the sedatve to prepare him for surgery. She chattered brightly as she prepared the hypodermic.

"You know, you have all the nurses speculating, Mr. Lee. I mean we're wondering just what Dr. Lakin, he's the anesthesiologist, is going to use for you when you won't have any brain for the anesthesia to work on." She stopped, the needle poised above Lee's arm, realizing the inaptness of her remark. "Oh. I shouldn't have said that."

"No, that's all right," said Lee. "I've already reconciled myself to being the headless horseman for a while." He had, too, although it was wonderfully strange to think of himself lying on the operating table with a cavity where he right now thought, felt, *knew* that he was a person.

Lee didn't actually lie on the table in the literal sense. The table was inclined to about forty-five degrees, with his head exposed and supported by a clamp on the cheek and jaw bones. This arrangement was necessary to allow the waiting machinery access to the area where it would perform.

Physicians, surgeons, biologists and the like were gathered in the amphitheater to see a bit of medical history. Actually there wasn't much to see. A team of technicians, radiologists and surgeons were working around Lee. Some were attaching electrodes to parts of Lee's body to maintain the electrical impulses necessary to keep his vital processes in motion while the main switchboard was out of commission. Others were sensitizing the exposed brain, from which the skull had already been removed, to guide the delicate fingers of the huge automatic Operating, Recording and Calculating Complex through its precisely programmed steps.

Letzmiller was among those in the amphitheater, as a spectator, drawn both by professional curiosity and a desire to know the answer to Lee's question, "Doc, what will there be left of *me?*" Of course he couldn't find out even part of the answer for some weeks. Even the ORC complex, now being fitted to Lee's unconscious brain, adjusted and activated, would not finish with its job for something like thirty-two hours.

The synthesizer would reconvert the data, translate it into countless chemical and electrical formulae, and apply it to the raw material of carbons, amino acids, proteins, and other components. When the basic organ had been reconstructed, a process requiring another week and a half in the synthesizer, it would be grafted back. The nerve lead-ins would then be reconnected, one by one, spaced at intervals to avoid shock. Lee would be unconscious the whole time, of course. Or rather Lee would be unconscious part of the time. Most of the time he wouldn't have the capacity for either consciousness or the lack of it.

Dr. Letzmiller observed the huge ORC complex for a time, but there wasn't anything to see. It simply sat over Lee, doing its job. Unwanted, the thought came to Letzmiller that the machine looked like a frog with a long worm dangling from its mouth. Lee was the worm.

"You can talk to him now, doctor." Oldenreid, Surgeon in Charge, addressed Letzmiller outside Lee's room where he had just finished his examination. "Personally, I think things went exactly as they should. All physical and mental responses check out. I guess here's where I'm finished and you go to work."

Lee was sitting up in bed as Letzmiller entered. He looked just like he had in Letzmiller's office before the operation, except for the small white bandages around his head to protect his healing skull. "Well," the doctor said, "how do you feel? Your head hurt?"

Letzmiller checked at Oldenreid's office, and was admitted to give his report, as had been planned.

"Well?" asked Oldenreid.

Letzmiller lit the end of his cigar before answering. "I wholly agree with you. Everything seems to have worked out exactly according to plan. I found him essentially the same as he appeared to me during his pre-operative interview. Of course he's a little foggy yet, but I suppose that's just the post-operative shock."

"Yes, that will clear up in a few days."

"He seems alert, responsive, full memory. I don't think there will be any difficulty with my part of his post-operative treatment. Except—

"Doctor, have you ever listened to a group of violins and sensed, just sensed, not actually heard, that one of them seemed about a quarter of a note flat?"

Oldenreid looked at him strangely as Letzmiller left the office and closed the door. ■

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IN TIMES TO COME

Next month brings a first novel by a new two-headed author—Walt and Leigh Richmond. Leigh Richmond was with us a year or two ago with "Prologue to an Analogue"; this one—done in collaboration with her engineer-husband—is "Where I Wasn't Going." And it concerns the UN's first space station . . . but the story is, basically, simply that it doesn't solve the ancient problems of the willfulness of individuals to establish a world government! And the fact was, is, and will be that where some men see a great industrial economic tool, others see only a weapon to rule with. And it makes not the slightest difference what the level of technology is, nor the level of government—city-state, kingdom, nation, or world-government.

The yarn has, moreover, provided Jack Schoenherr with an opportunity for a cover picture that's a classic. Oh, there have been paintings of the wheel-type station in space before this. But after you see this one, you'll realize that those were just practice attempts; Jack's done The Picture. One of the peculiarities of the picture, by the way, is that the mood—the feeling-tone—of the picture changes drastically when you rotate it. One way it's as menacing as a tornado sky; another, it's as calm as a moonlit night. And the way we're running it, it's as dynamic as a racing car roaring toward you!

And the article next issue is "The Geodetic Satellite." Contrary to popular belief, Columbus' trouble wasn't that people thought the earth was flat, but that Christopher was nuts to think the Earth was only about ten thousand miles around. They knew it was about twenty-two thousand miles around.

The facts are (1) it isn't spherical, and (2) we don't know what shape it is and, moreover, (3) we don't know how big it is even yet!

THE ANALYTICAL LABORATORY

PLACE	STORY	AUTHOR	POINTS
	JUNE 1963		
1.	Territory	Poul Anderson	1.51
2.	The Trouble With Telstar	John Berryman	2.36
3.	Hermit	J. T. McIntosh	2.51
4.	Ham Sandwich	James H. Schmitz	3.54

THE EDITOR

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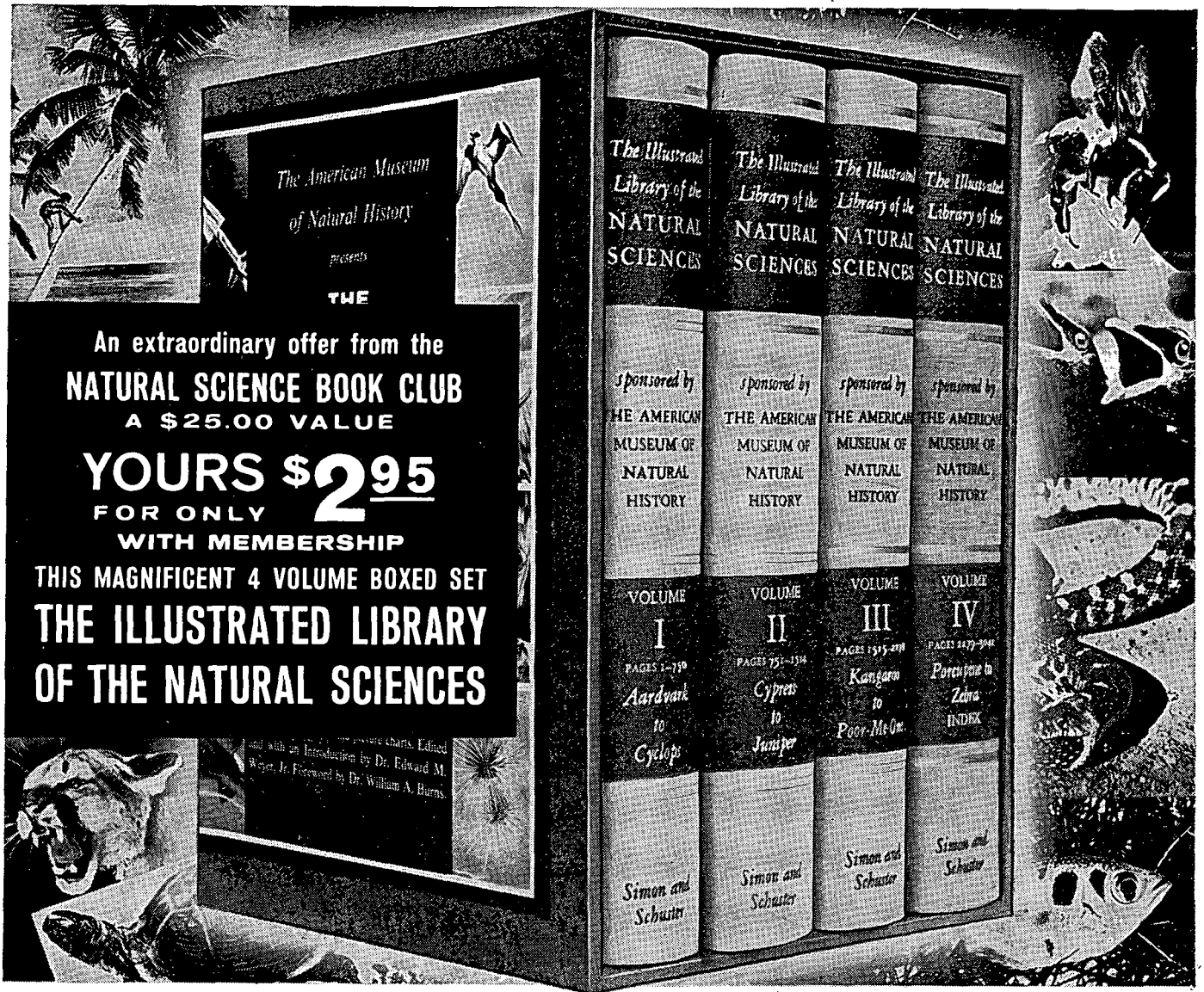

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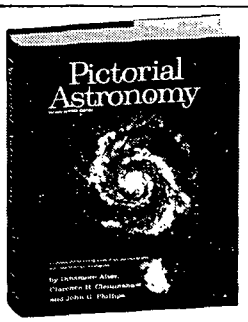

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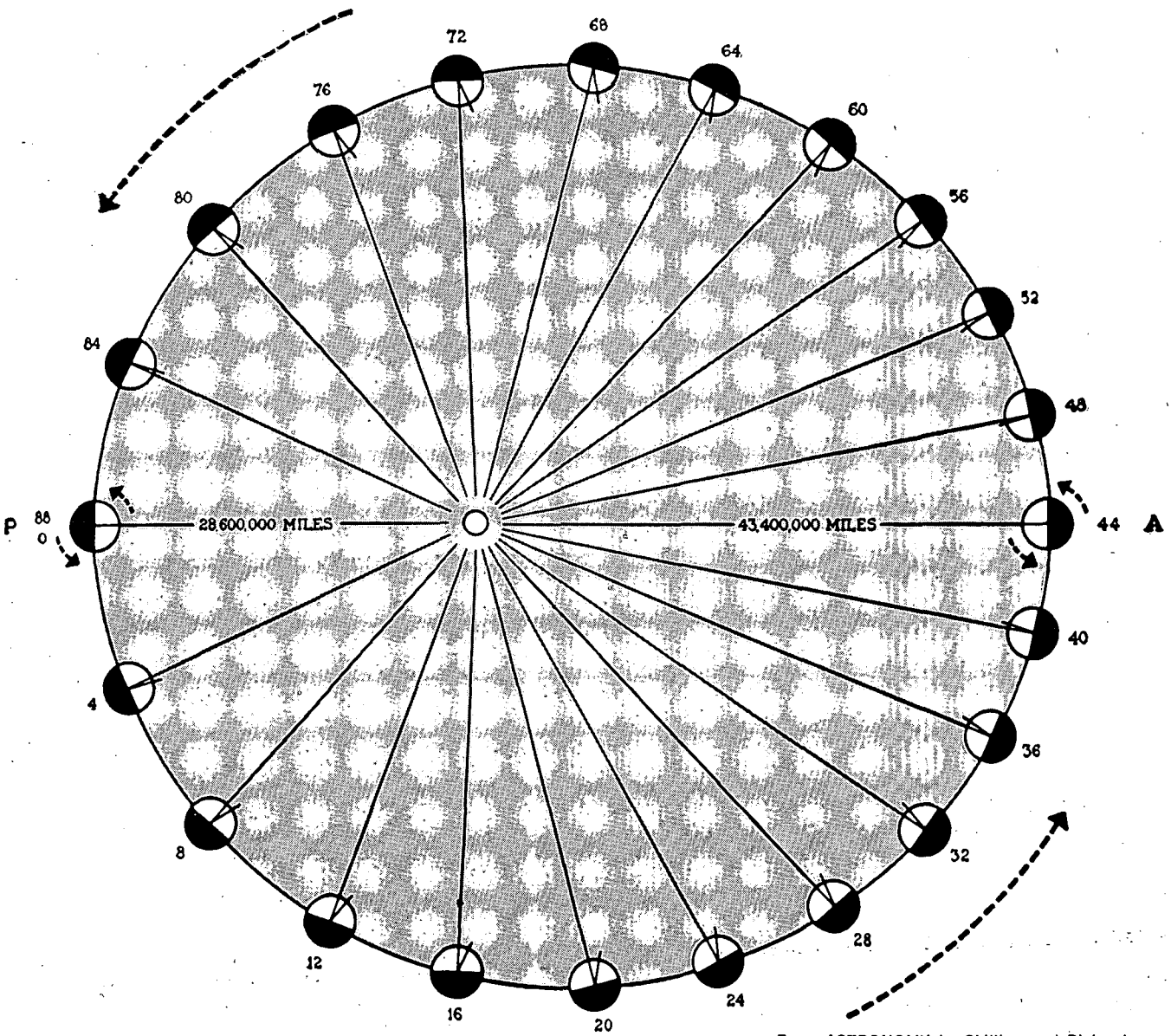
WHICH POLARIS DO YOU MEAN?

continued from page 16



From ASTRONOMY by Skilling and Richardson, courtesy Holt, Rinehart, and Winston

Fig. 7. *The rotation period of Mercury has not been definitely established but is probably 88 days, the same as its period of revolution.* On the average *Mercury always keeps the same side turned toward the Sun. Observations of surface markings indicate the planet's axis of rotation is nearly perpendicular to the plane of its orbit.*

Since the orbit of Mercury has a considerable eccentricity of 0.206, its rate of revolution varies widely as it swings around the Sun. But its rate of rotation is always the same. As a result, the two get out of step with each other during the course of the year. To an observer on the sun-lit side the Sun would appear to swing monotonously to the east and west in the sky. This motion is technically known as the "libration in longitude."

The only region on Mercury that might be inhabitable would seem to be the narrow region on the edge of the zone of libration, where the Sun is alternately above and below the horizon by a few degrees.

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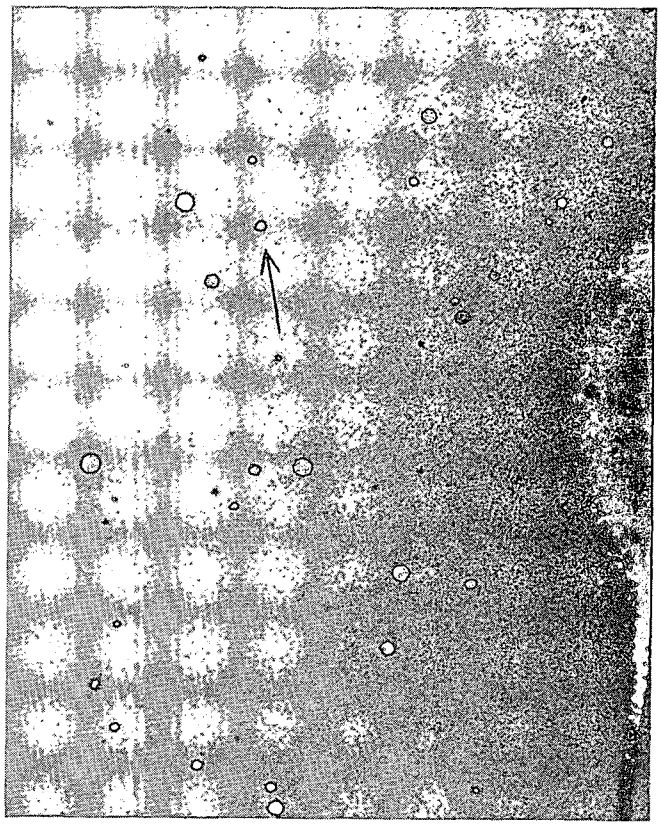

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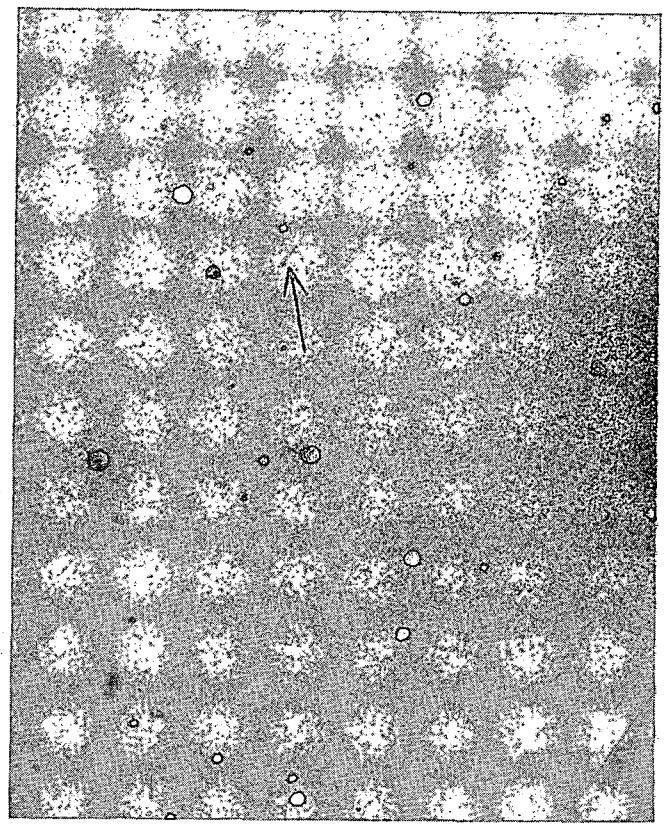

MARCH 23, 1930

Fig. 8. *Two views of Pluto showing its motion among the stars in one day. It seems incredible that we have a value for the rotation period of this planet which can never come closer than about 2,660,000,000 miles. It does not show a disk but has an image indistinguishable from those of the stars, as seen here. But from slight variations in brightness its rotation period appears to be 6.390 days. This shows the power of electronic methods when applied to astronomical problems.*

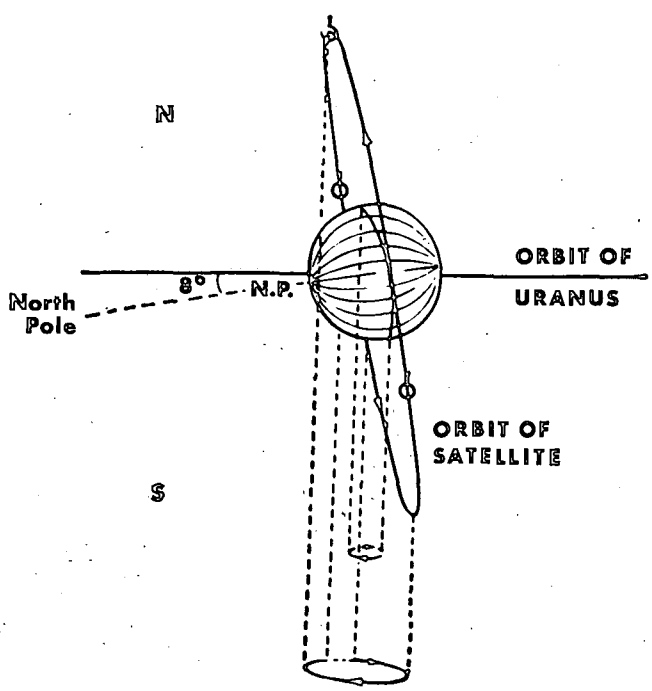

Fig. 9. *The axis of rotation of Uranus is tilted at such a large angle to its orbit plane, that its north pole is 8 degrees on the south side. The direction of rotation of Uranus has been found to be the same as the direction of revolution of its satellites. An observer looking toward Uranus in the direction of the dotted line would see the satellites revolving counterclockwise. By definition this is regarded as the north pole of the planet.*

As a result, the satellites sometimes appear to us to be revolving around Uranus in circles, and at other times to be moving back and forth in nearly straight lines. If the Earth had such an axial tilt as Uranus we would experience tremendous extremes in temperature during the year. On Uranus it probably doesn't make much difference. It is so far from the Sun that it is always *cold on Uranus.*

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WHICH POLARIS DO YOU MEAN?

conclusion

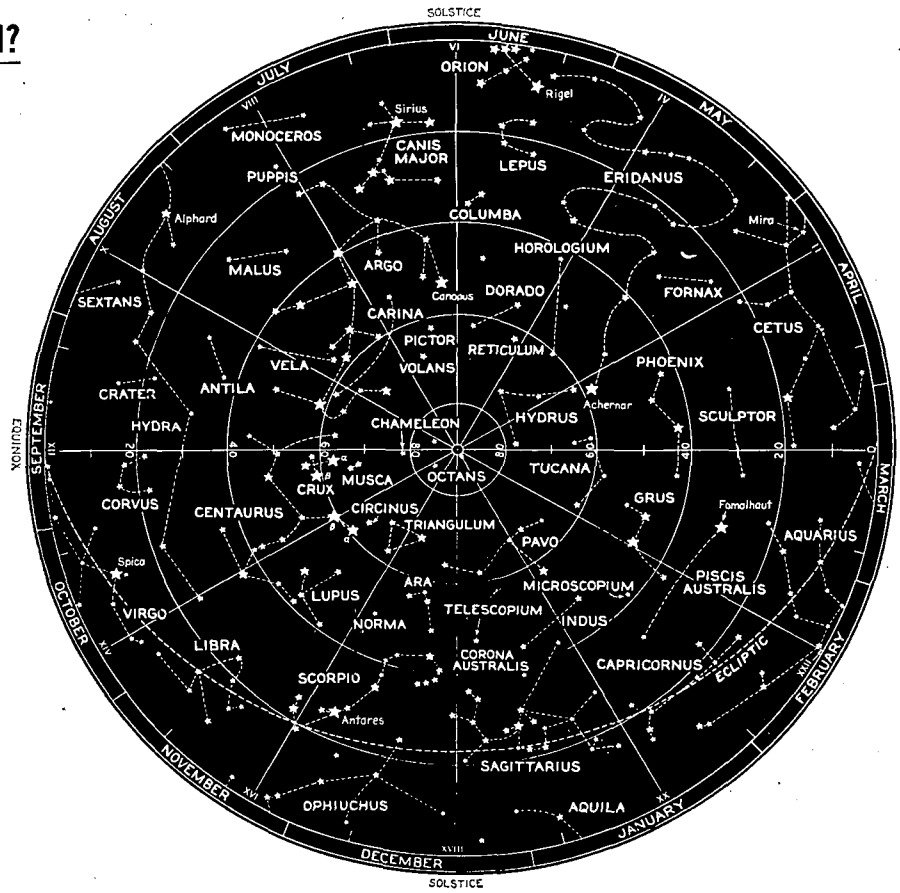

Fig. 10. *The circumpolar constellations of the southern sky. Notice that although no good North Star can be found for the Moon, our satellite has a splendid South Star in Canopus, the second brightest star in the sky, at RA 6^h, DEC 65 S.*

Here is where readers can take a hand. I expect that everybody will not agree with my choice of North Star and South Star. Often in selecting a Polaris, you have to decide between a bright star, and another star that is fainter but closer to the pole. You can have some fun by getting a star map and picking out your own Polarises.

So far as I am aware the material in Table I has never been assembled and published before. I wouldn't be surprised; if there are some errors in it. The danger is that somebody will copy it into their book, and somebody else will copy it out of that book into their book, and so on *ad infinitum*. Mistakes have been propagated through the literature of science for half a century that way. ■

TABLE I

OBJECT	RA	DEC	NORTH STAR	SOUTH STAR
Sun	19^h 04^m	63° 48′ N	Delta Draconis	Alpha Mensae
Moon	18 00	65 01 N		Canopus
Earth		90 00 N	Alpha Urs Min	
Mercury	18 44 ?	61 22 N ?		Alpha Mensae
Venus (K)*	3 22 ??	81 N ??	Alpha Urs Min	Alpha Apodis
Venus (R)**	20 44 ??	64 N ??	Eta Cephei	Alpha Volantis
Mars	21 11	54 42 N	Alpha Cephei	Kappa Velorum
Jupiter	17 52	64 33 N	Zeta Draconis	Delta Mensae
Saturn	2 34	83 24 N	Alpha Urs Min	Delta Apodis
Uranus	5 05	14 56 N	Aldebaran	Eta Ophiuchi
Neptune	19 44	41 41 N	Delta Cygni	Theta Arae
Pluto	20 54 ??	66 28 N ??	Alpha Cephei	Beta Carinae

**Kuiper* ***Richardson*

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BRASS TACKS

continued from page 5

lieves, on the basis of that demonstration, that the device indeed works, at least under certain conditions.

However, we do wish to report our own experimental results for the benefit of others who may be baffled by their inability to reproduce Mr. Dean's results. Keep in mind that even a 3° leading phase angle casts some doubt on the classical methods of analysis of such devices.

A 3° phase angle could be accounted for by the inclusion of the third order term and its coefficient (D m) in the equation of motion of such devices. The particular solution of the equation is of the form:

$$X = \frac{F_o \cos(\omega t - \alpha)}{m\omega^2 (1 + D^2\omega^2)^{\frac{1}{2}}}$$

Where the phase angle:

$$\alpha = \tan^{-1} D\omega$$

and:

F = Amplitude of the applied oscillating force
m = Mass of the system
w = Angular velocity
D = Critical action time

As these equations show, the phase angle clearly depends on the speed (w), whereas Dean observes constant phase angle of 45° at all speeds ranging from 150 to 750 RPM. This is equivalent to critical action time of from 64 to 13 milliseconds. We, however, did not notice any observable phase angles below 500 RPM, and above that speed the phase angle consistently increased up to a value of 3° at a speed of 1000 RPM, at which point the components failed due to excessive internal stresses. The calculated value of critical action time of our device was about ½ millisecond. Other experiments carried out in our laboratory indicate that devices of these dimensions have very low values of critical action time; i.e., much nearer ½ millisecond than 64 or even 13 *milliseconds*.

We would be most interested in hearing of any results obtained from similar experiments by any of your readers. In closing, we would like to remark that, upon reading Mr. Dean's letter, we resurrected the equipment from the 1961 experiment and repeated it with entirely different observing and operating personnel, only to confirm our earlier results.

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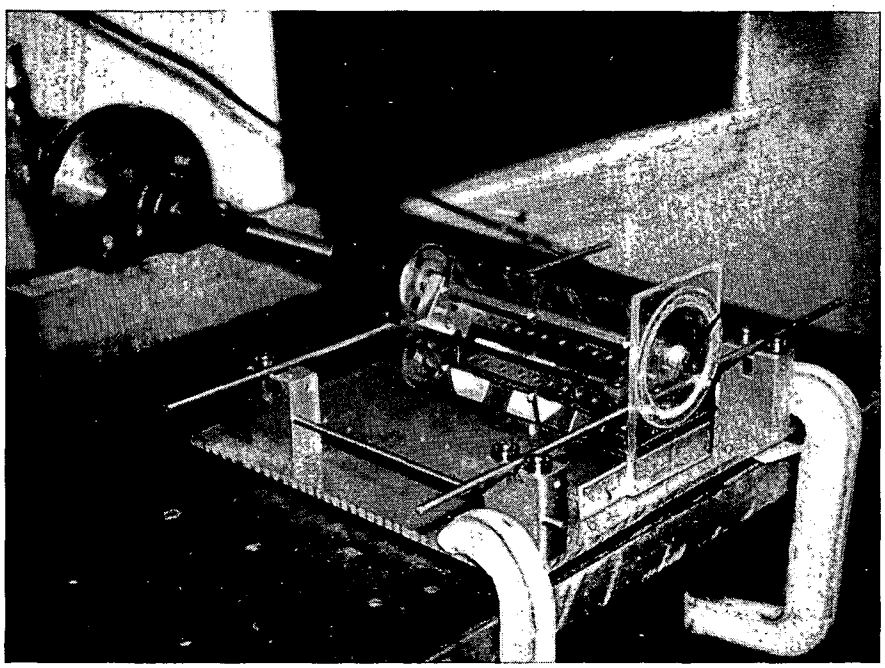
Huyck Research Center,
209 Greenwich Avenue,
Stamford, Connecticut.



Photograph of the experimental equipment utilized by the authors at Huyck Research Center laboratories. Huyck Corp. photo taken May 9, 1961.

Report on Test-and-observe data!

•

Dear Mr. Campbell:

The article on Solid and Liquid Fuels is very good and full of information. However, guncotton when wet has been issued for years as a demolition item in the British Army. I think they call it "Guncotton, wet, charges, field" or some such, and caps *will* fire it. Did you see the TV show recently about a man who accidentally made nitroglycerin in a plating bath? Made a lot of fun for a half hour. Nitro is easily made and more easily initiated. I know an Army EOD man who got a call that a kid had made some in his chemistry lab, and expecting a test tube, found himself nursing a full quart for thirty miles by highway! Fun among the amateur earth-wreckers, no?

JOHN P. CONLON
52 Columbia Street,
Newark, Ohio.

Beginner's luck, no doubt!

•

Dear Mr. Campbell:

I enjoyed your February 1963 editorial very much, and as a result, have tried to express Finagle's Law:

As humans we
Are equals, see
What's good for me
The same for thee*
Is good for us
So without fuss
We'll do for thee
What's good for me.

R. B. ROWE, M.D.
1501 North Coler
Urbana, Illinois

We never SAY that—we just DO it!

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BRASS TACKS

Dear Mr. Campbell:

Leave us, if I may say so, stick to things we understand. If you describe Latin and Greek as "dead" languages you are ill-informed. When, may I ask, did Greek die? How can Latin be called dead when it is the official language of a State; when, having been the international language of all educated men, it is still the vehicle of communication (I correspond in Latin with people whose native language I cannot understand) and, above all, a language in which original, creative poetry is written?

The Latins—you probably mean Romans—had no word for "yes?" Who told you that? Of single words meaning "yes", leaving aside other ways of affirmation, I offer "ita," "sane", "etiam"—and there are more.

Latin is, in fact, *the* ideal international language, provided everyone, as did the Turks, switches to Latin script; it is completely phonetic, logical, concise and—this may surprise you—capable of expressing any modern terms of technology, electronics and what have you. A permanent commission of Latinists, editors of the periodical LATINITAS and presided over by former Monsignore, now Cardinal, Bacci, is constantly at work, extending the Latin of Cicero to things and concepts not known in his time. A fourth edition of Bacci's "Lexicon" has just appeared: it contains novel terms ranging from rocketry to golf, from spaceships to computers.

May I conclude with a friendly *ne sutor ultra crepidam* or "cobbler, stick to thy last?"

DR. HARRY C. SCHNUR
Associate Professor of Classical Languages
Iona College
New Rochelle, New York.

O.K. friend—argue the meaning of "living language" with the Esperantists!

•

Dear Mr. Campbell:

No one who wishes to see the human race go beyond the boundaries of the solar system can be very happy with the light-speed velocity ceiling established by relativity. At least the time-dilation effect is a small consolation, as it will, assuming a ship under a continuous one-gee acceleration, which is reasonable for a true space drive, allow us to get to any point in the universe within one—a long one, though—lifetime. But there remains the difficulty that when you return from your jaunt to Andomeda, you find that everyone you knew has been dead for two million years.

I remember a letter in Brass Tacks some time ago expressing the opinion that there must be a "bugger factor" somewhere in the relativity equations which can somehow be gotten around. It certainly would be a relief if there were.

I am only a high school student, and all I know of relativity has been learned from sources employing only the most rudimentary mathematics, and thus is of no high degree of sophistication. But I have run across something which, I hope, may eventually be developed into something like an answer. It is that, to the best of my knowledge, the principles of relativity have never successfully been extended to deal with situations involving variable accelerations. As I understand it, the equations just do not give results where acceleration is not constant.

What does this mean to the would-be instellar traveler? That it means that variable accelerations are impossible is contrary to fact. Most automobiles do not accelerate at a constant rate, and thus are outside the province of relativity theory in its present form.

Several possible situations suggest themselves, and maybe one of them is something like what really happens. First, that the c-limit holds and that instantaneous flow of subjective time follows in the normal relativistic manner from instantaneous velocity. Second, that, with light-speed still your top, the time-dilation effect is heightened beyond mere direct extension of the effect for constant accelerations. These two possibilities may make it possible for you to make your trip to the next galaxy in a matter of months or weeks instead of years, but it's still 2,001,963 A.D. when you get back.

The third possibility—and the one to dream on—is that in some way the varying — acceleration system "goes Newtonian," and enables you to break the speed limit, so that you can get home without missing more than a couple of the kids' birthdays.

This last notion is actually no more improbable than the first two—because the equations tell us only that we know nothing about variable—acceleration situations. Philosophically, it may be possible to go faster than light and still get away with it. The rule is that neither energy—including matter—nor information—which requires energy to carry it—may be transmitted at a velocity greater than that of light. But the rule need not be broken even if you make your trip to Andromeda in just a weekend, because there is no way of measuring to see if the rule has been broken when you get there, and because there is no way of proving conclusively that you were ever there, once you come back. Even if you bring back a souvenir watch fob, there is, again, no way of checking whether it has broken c until you take it back because you want to complain about the workmanship or something, and then it's the same for it as if it never left. Mere re-arrangements of matter and energy in your spaceship, such as the snapshots you took, don't count against you; for all the speed limit knows, they're table-tops done on board the ship during the time you say you were going out and back.

Of course all communication with the rest of the universe will cease when you go super-light. This is one concession that must be made to relativity, and will be the meaning of the word hyperspace. One assumes that communication is restored when one decelerates to sublight velocities.

Assuming a system under such "Neo-Newtonian" principles, in which acceleration in centimeters per second per second is equal to elapsed time in seconds, lightspeed would be reached in 2.45×10^5 seconds, or 2.84 days. However, the acceleration at this time would be up to 250 gees, so that pas-

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sengers would require rather special survival equipment.

A more reasonable arrangement might be to have varying acceleration:

$$a = 1000\ (\sin t + 1),$$

so that acceleration would be constantly varying between zero and two of ANALOG's "Standard Gees" of 1000 cm/sec^2 each. This should be bearable for fairly fit human beings, although rate-of-onset effects must, of course, also be taken into account. At this rate it will take you about 3.0×10^7 seconds to "go illegal"; this is something like a year and three weeks, not allowing for time dilation—since we cannot predict its effects here—and is not an unreasonable length of time.

One of the Stupiditheorems says that: "The probability of predicting correctly in total ignorance is zero." And this is essentially what I've been doing here. But the possibilities—each about as likely as any other—are amusing, and may arouse interest in investigating the relativity of variable-acceleration systems, which seem to be our last remaining chance of finding a way to go to the stars and have anybody living to tell it to when we come back.

STEPHEN WALTON
41 Westview Avenue,
White Plains, New York

Hm-m-m—maybe he has a really good answer, maybe not, but he certainly has a first rate problem-for-study!

•

Dear Mr. Campbell:

Leinwoll's new proposal for detecting distant planets is fascinating to distraction. May I just amplify one point?

Leinwoll and Nelson believe that changes in solar—and stellar—radiation depend on the changing angles various planets make with their sun. Now the angle between two planets is a function, not of their orbital periods, but of their *synodic* period. A synodic period is the time between successive conjunctions of two planets—the "beat frequency," as it were, between their orbital rhythms. It can easily be calculated from the orbits—*but they cannot be calculated from it.* Just as you can't tell, from looking at a sum, what numbers it's the sum of.

And it's the orbital periods that we need to find out. There's no other way to judge whether a given planet is "habitable."

There's a synodic period for every possible pair of planets in a system. So our nine planets have thirty-six synodic periods between them, ranging from months to centuries. Fortunately, according to Leinwoll and Nelson, only four planets have much effect on the sun, and these four have only six synodic periods:

Earth-Mars	2.14 years
Earth-Jupiter	1.09 "
Earth-Saturn	1.04 "
Mars-Jupiter	2.24 "
Mars-Saturn	2.01 "
Jupiter-Saturn	19.85 "

Curiously, none of these come close to the 11.09-year (or 22.18-year) sunspot cycle. I would have expected the sun to follow the Jupiter-Saturn periodicity. It doesn't. Evidently we haven't got to the bottom of this yet.

Neither do the synodic cycles give away the planets' orbital periods. Some are close, but only approximate. So now what?

To get any closer we have to make some kind of assumption about the relationships between orbits. With atoms it's easy: all orbits are determined by quantum numbers. But quantum numbers don't apply to solar systems. In theory you can put a planet anywhere.

In fact though you don't find planets straddled around helter-skelter. In the Sol System they follow a sort of "quantum-spacing" rule known as Bode's Rule. But is Bode's Rule a real law, or just a massive coincidence? We don't know yet. And it doesn't seem to work out for Neptune and Pluto.

The trouble is, we have no other known relationship between orbits to go on. If we don't try something like this, we stay stuck in the starting gate. So let's assume, until we know more, that Bode's Rule applies to neighbors like, say, Upsilon Andromedae, fifty light-years away. Then we can set up problems in the form: "Given the estimated mass of Upsilon Andromedae, find two orbits around it such that (1) their radii are in a Bode-number ratio and (2) their synodic period is (let's say) 989 days."

This solves nicely. But it gives a different pair of answers for each pair of Bode numbers. Only one set is right, but you can't *a priori* tell which. You have to calculate as many orbit-pairs as endurance permits, and repeat for each synodic period that the star's light-curve reveals. Then you compare answers and throw away the 98% that don't match. Or program a computer to do it for you.

By this method you can build up a complete planetary system on paper (complete, that is, after about two hundred years of observing). There's only one catch in it: your assumption of the validity of Bode's Rule may be dead wrong. Your paper planets may resemble nothing that's really there.

So what's wrong with trying?

The effort required, for one thing. You will need a small army of observers, each with a photometer accurate to .01 magnitude. You'll need at least twenty years' worth of measurements in red light, blue light, IR, UV and when possible RF. You'll need a band of loyal spies in the big observatories to measure old star-field plates. And you'll need a good man to collect and collate data against the day when there'll be enough to start analyzing. I nominate Mr. Nelson.

These devotees could perhaps call themselves the American Association of Stable Star Observers. If any man be mad enough to tackle such a program, I have at my elbow a handy list of the hundred nearest Sol-type stars, culled from the Yale catalog of parallaxes. It lists name, position, magnitude, type and distance, and it's two bits a copy.

RICHARD R. MOORE
69 Oak Hill View
Rochester 11, New York

Well—it would help if we just understood how planets are formed. But I understand a law very like Bode's Law applies to the satellite system of Jupiter and Saturn!

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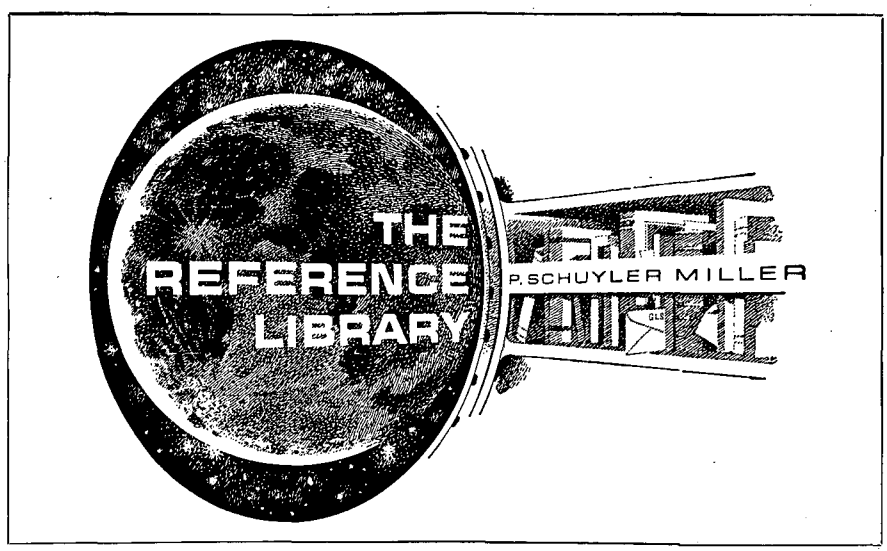

GRAB BAG

Of making science-fiction anthologies there is to be, it seems, no end. Ten of them are piled up on the desk in front of me at the moment, seven of them original paperback collections, three—praise be! — reprints. One contains three novelettes, another fifty short stories. Among them, they perpetuate one hundred and twenty-seven stories, some well known, some not, some recent but mostly pretty old. I haven't the stamina or Analog the space to follow my usual practice of telling you what is in each book—for which you should be duly grateful.

By-and-large, these are the second-string anthologies. Analog, *Fantasy and Science Fiction* and *Galaxy* have their own regularly appearing collections to skim off the cream of the current crop. Judith Merril covers the rest of the field every year with admirable catholicity and diversity. Individual authors have frequent paperback collections—some long overdue. There's not much left for the occasional anthologist, and these collections show it.

Five of the new anthologies—they are all paperbacks—and one of the reprints are "theme" collections: four about interplanetary explorations, one about robots, one about doctors. None is outstanding; they range from poor to not bad.

The poorest of the lot is "Exploring Other Worlds," edited by Sam Moskowitz, whose forthcoming collection of brief appreciations of SF writers should be our *piece de resistance* here next month, if it is published on schedule. Although the book isn't stigmatized by a "YA" or "J" or any similar brand, it seems to be one of a series of paperbacks for teen-agers that Collier Books is bringing out at its usual ninety-five-cent price. This may be the reason why the editor—or perhaps the publisher—has set the level of the eight stories at "simple" in concept and handling. Only Stanley G. Weinbaum's "Mad Moon," with its diabolical little slinkers, has any distinction, and some of the science is sadly outmoded or Sunday-supplement. This one is Collier No. AS-551 and has 256 pages.

A far better bargain—and better science fiction—is Pyramid Books' No. F-852, a re-reprint of the 1950 Gnome Press interplanetary anthology, "Men Against the Stars," edited by Martin Greenberg. It was good then; it's good now, and will cost you only forty cents for 191 pages. Also a good job is Donald A. Wollheim's collection for Ace Books, "More Adventures on Other Planets"—No. F-176, 190 pages, 40 cents. The yarns range through the solar system from Vulcan to Uranus and out among the stars, and some of them are as old as Moskowitz's selections, but they have the important difference of being eminently readable. Robert Moore Williams' "Red Death of Mars" is in both the Greenberg and the Wollheim collections.

Paperback Library charges fifty cents for its No. 52-211, a 176-page paperback called "Contact" and edited by one Noel Keyes. These stories average out about a decade later than those in the previously mentioned interplanetary anthologies. Their linking theme is that of different approaches to first contact between men and a nonhuman species—in Murray Leinster's "First Contact," in Howard Fast's "The Large Ant," in Ray Bradbury's "The Fire Balloons," in Isaac Asimov's "The Gentle Vultures," and in some others of the same caliber, by writers in the same league. The first half of the book shows Man discovering other creatures and cultures; the last, opening with the script of Orson Welles' cataclysmic broadcast of H. G. Wells' "War of the Worlds" transplanted to New Jersey, shows us as the discovered.

Sam Moskowitz did far better with "The Coming of the Robots," his second juvenile collection for Collier Books—No. AS-548, 254 pages, 95 cents—than with his interplanetary story. The stories may be just as familiar—Eando Binder's eternal "I, Robot," Lester del Rey's "Helen O'Loy," John Wyndham's "The Lost Machine," Isaac Asimov's "Runaround" —and they average even older than those in "Exploring Other Worlds," but they are better stories. This one *is* a good place for a teen-ager to start; the other isn't.

Groff Conklin has a hand in two more Collier anthologies, one of them a theme collection, "Great Science Fiction About Doctors"—Collier No. AS-518, 412 pages, 95 cents—which is edited in collaboration with Noah D. Fabricant, M.D. This appears to be a labor of love on which the editors have been working since 1954. I suppose

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Hawthorne and Poe add some class and an air of stability, and perhaps the few fantasies can be justified on the strength of good writing, but I should have liked to see one of James White's stories about "Sector General" and one of L. Ron Hubbard's "Ol' Doc Methusaleh" yarns from these pages of long ago. Not every story in the eighteen collected is on the level of C. M. Kornbluth's "The Little Black Bag," who bites deeper every time 'round, or is as amusing as Murray Leinster's "Ribbon in the Sky" or Alan Nourse's "Family Resemblance," but the general level is high.

So is it in Groff Conklin's second Collier anthology of the still-young year, selected jointly with Isaac Asimov. "Fifty Short Science Fiction Tales"—Collier AS-516, 287 pages, 95 cents—opens and closes with poems by the writing Andersons, Poul and Karen, and packs just about every kind of SG going into the space between. All the big names are there with little stories—the slight kind with a snapper at the end. It may seem that some themes are overdone, such as the visitor from the future, but the rapid-fire variation in styles and approaches offsets that. Groff Conklin and Isaac Asimov have, indeed, murdered the axiom that the only good science fiction is long science fiction. They have also nicely demonstrated its infinite variety.

Another non-"name" editor, Ivan Howard, has assembled a good and varied lot of eight stories for Belmont Books under the name "Rare Science Fiction"—Belmont No. L92-557, 173 pages, 50 cents—and the publisher has done his best to handicap the book with nonsensical cover claims. They're called "prize-winning" stories, but I can't recall that any of them ever won a prize, other than an editor's check. They're said to be "appearing for the first time in any book," and that isn't true either: L. Sprague de Camp's "Let's Have Fun," for example, is in his own latest hardback collection, "A Gun for Dinosaur." None of this should prevent your reading a good all-around selection with such gems as Alice Bullock's poignant little "Asylum" or Milton Lesser's wry "Do It Yourself."

The two reprint anthologies remaining at the bottom of the current pile are both standard-quality stuff. Crest's "Five Tales From Tomorrow"—No. d-597, 176 pages, 50 cents—has been excerpted from the former annual, "The Best Science-Fiction Stories and Novels: 1955," edited by T. E. Dikty. Tom Godwin's classic "The Cold Equations" and Everett B. Cole's "Exile" both appearing in Astounding first. Ballantine Books has reprinted the three novelettes which originally appeared as "Star Short Novels," edited by Frederik Pohl. The new edition is Ballantine F-730; 168 pages for 50 cents. The stories: Theodore Sturgeon's "To Here and the Easel," Lester del Rey's religious shocker, "For I Am a Jealous People!", and Jessamyn West's so-so "Little Men."

With the exceptions I have pointed out, one of the shorter of these anthologies gives you the variety that you would expect in an issue of this or a similar magazine, and about the same spread of high and low quality that is routine. With the big Collier grab bags you get a bargain; with the antiquities, you're probably stung—unless some of them are so old that you've never seen them. Of the lot, the collection of doctor stories is probably the best buy.

* * * * *

Voting for the 1963 Science Fiction Achievement Awards—the "Hugo's," named for Hugo Gernsback—closed July 1st. If you had a membership in the 1963 Convention, to be held in Washington, at the Statler-Hilton, over the Labor Day weekend, you've had a chance to vote for your favorite. If not, you can still join the convention—right up to the time it starts—but it's too late to elect a winner.

For your information, the finalists, from whom the winners will be selected, were as follows:

Best Novel of 1962: Philip K. Dick's "The Man in the High Castle"—my own choice; Arthur C. Clarke's "A Fall of Moondust"—perhaps the most likely to win; H. Beam Piper's "Little Fuzzy"; Marion Zimmer Bradley's "Sword of Aldones"; and a hardback fantasy about a fox that turned into a woman, Vercors' "Sylva," which wasn't mentioned here.

Best Short Fiction: three out-and-out fantasies, Fritz Leiber's Grey Mouser story, "Unholy Grail," Gary Jennings' "Myrrha," and T. B. Swann's "Where Is the Bird of Fire?" from the English magazine, *Science-Fantasy;* plus Jack Vance's bizarre "The Dragon Masters"; plus Theodore Sturgeon's "When You Care, When You Love." None of the contenders, alas, are from Analog this year.

In the Best Drama field, TV's "Twilight Zone" is contending again against that fantasy d'estime, "Last Year at Marienbad," the competently produced British film, "The Day the Earth Caught Fire," and the pretty-good remake of Fritz Leiber's classic Unknown Worlds story, "Conjure Wife," filmed under the A. Merritt title, "Burn, Witch, Burn."

Best Magazine: the British *Science-Fantasy* made the finals this year; familiar contenders and past winners include Analog, *Galaxy*, *F&SF* and *Fantastic Stories*. Best Artist: John

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Schoenherr for his work here, Ed Emshwiller for his work in many places, Virgil Finlay, Roy Krenkel for his covers on the Ace Burroughs paperbacks, and J. Gaughan, on the strength of his illustrations for Vance's "Dragon Masters," which seems to have stirred up a storm.

Among the fan-published magazines, such veterans as "Yandro," published by the Coulsons, Richard Bergeron's "Warhoon," Los Angeles' "Shangri L'Affaires," take on the less well established "Xero" published by Pat and Dick Lupoff—Dick is the Canaveral Press editor in charge of the Burroughs hardbacks, and Jack Chalker's "Mirage."

According to the latest word I've had, the Discon will start with registration and general foregathering Friday afternoon, August 30th. Some will get there earlier. The program begins Saturday noon and runs through Monday afternoon. Highlights include the costume ball Saturday night; banquet —with Murray Leinster as long-overdue Guest of Honor and speaker—Sunday afternoon; exihibition of non-professional art throughout. Informalities, likewise, throughout. Send your $2.00 to the Discon Treasurer, Dr. William H. Evans, Box 36, Mount Rainier, Maryland, and put another dollar in the pot when you get there, or pay it all in advance, as you prefer. Three progress reports have already been published.

WITCH WORLD
by Andre Norton
Ace Books, N. Y.
No. F-197 • 1963 • 222 pp • 40¢

In this original story, Andre Norton creates a new world with new but ancient races, interjects an adventurer from our own time, and lets the plot take its course with her inimitable talent for action and unresolved mystery.

Simon Tregarth, transported to the witch world by the so-called magic of his own, finds himself among people to whom magic is also very real and very powerful. To Tregarth's earthly eyes, this magic of the Witches of Estcarp seems more like the fragments of forgotten science—and he is to find other fragments in the possession of other people: the giant sea-rovers of Sulcar, for example, with something very like a nuclear reactor deep in their ancient fortress. Then there are the people of Gorm, swallowed up and weirdly changed by the strange folk from over the seas, who to Tregarth's more sophisticated judgment sound very much like creatures or men from another world, bent on conquering this one.

The strangeness flows like rich wine, the action rolls and flashes—in short, here's another by Andre Norton, this time *not* a reprint of a book for teenagers.

RECALLED TO LIFE
by Robert Silverberg
Lancer Books, New York.
No. 74-810 • 1962 • 144 pp • 75¢

The publisher's introductory blurb says: "Robert Silverberg's greatest novel has been unaccountably ignored by book publishers until now." I'll second that notion; the book, published in *Infinity* in 1958, is by far the best its author has done and deserves the Hugo nomination it didn't get.

The theme is not novel for science fiction; scientists develop a mechanico-chemical means of reviving the not-too-long dead, and have the problem of how this power is to be administered. The handling is what makes the book different.

The problem unfolds as seen by James Harker, an idealistic ex-governor of New York who has been slapped down by his party for trying to carry out his campaign promises. He is hired as attorney for Beller Research Laboratories, originators of the revivification process, and sets out to probe the political, legal and religious aspects. Then his hand is forced by a premature announcement, and Harker finds himself the buffer between the less-than-practical scientists and all the forces of a hard-nosed, hysterical society. Matters grow no better when the Senator who is heading the opposition is kidnapped, killed—and the reanimation fails.

James Harker's fully drawn character is what calms down the melodrama —even of his solution to the dilemma— and makes the book realistic. He is a man who *could* have been Governor of New York, and his handicaps are in his own character. Nor are all loose ends brushed up tidily; as the book closes, he knows that he is an accessory to murder.

SHIELD
by Poul Anderson
Berkley Books, N. Y.
No. F-743 • 1963 • 158 pp • 50¢

This is expanded from the two-part serial in *Fantastic Stories* for June and July, 1962. It has the Anderson smoothness, but not much of the Anderson distinctive flavor.

Koskinen is a physicist who, with the help of Martian philosophers, has been able to produce something like the potential barrier around an atomic nucleus, in the form of a generated, controllable shield. Safely inside, with an oxygen recycler and a supply of food and water, its carrier is just about invulnerable—though a laser beam can burn a hole through him readily enough, and an atomic bomb packs enough energy to get through the barrier. So, personally, would a cyclotron beam, though nobody tries that.

Koskinen brings his shield back to an Earth in which a *pax Americana* is enforced on the world, following the destruction of the war we have not yet had. Government police seize him, and are ready to kill him rather than let him fall into the hands of Chinese hijackers. He uses the shield to escape and winds up in the hands of a gang-lord with a highly attractive physicist as a mistress. Another Chinese attack gives them the opportunity to escape again, and shortly the pair are on the run with just about everybody after them.

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The latter chapters, and the final solution, document an important sociological principle: that the sincerity of a fanatic can be just as dangerous as the hypocrisy of an opportunist.

RIVER OF TIME
by Wallace West
Avalon Books, New York.
1963 • 221 pp • $2.95

My crib-sheet, Day's *Index to the Science Fiction Magazines*, doesn't help clarify which old short stories or novelettes were woven into this time-travel yarn—and I suspect there is at least one more than the publisher credits—but it doesn't really matter. Here is a short, slight, and thoroughly enjoyable venture into galloping anachronism, as four graduate students of 1965 vintage try to remake Roman history, and by doing so to create a continuum in which nuclear warfare will not destroy the world of their own time.

The theory of time around which the story is built is a rather novel one, too: that time machines are possible but impractical, for reasons demonstrated in the course of events, but that there are critical times in the course of history when the whole structure of the space-time continuum is stressed and faulted. At such times determined persons can slip through the cracks into past or future, and forces from one epoch make themselves felt in another. As the story begins, the narrator, chubby TV writer Ralph Graves, has found himself in a skirmish of the American Revolution—and this hint starts him on the road to Rome.

The goal of the three men and a girl —three different somatotypes, with a balanced harmonizer—is to prevent Julius Caesar's assassination and the collapse of the Roman republic. They leave their Rome as the first nuclear bomb is bursting, and arrive in ancient Rome with Caesar dead and the vultures gathering. Their problem: to divert the natural flow of greed, ambition and politics into channels which will make Caesar's Rome survive.

Doubtless scholars and historians, spoiled by such classics as L. Sprague de Camp's "Lest Darkness Fall"—*his* hero saved Rome at a much later time —will humpff and snuffle over the free-wheeling approach this author has taken. Cleopatra in nylons and a Paris gown, for example, creating a sensation among the dowdy Roman matrons —or the earlier Cleopatra, for that matter, sniffling in her Egyptian scanties, down-wind from the Roman factory district. So carp! This is one of the most enjoyable stories Avalon has had in quite a while.

THE ANCIENT ENGINEERS
by L. Sprague de Camp
Doubleday & Co., Garden City, N. Y.
1963 • 408 pp • $4.95

This book, and others like it, explains why there has been no science fiction from L. Sprague de Camp in some time. He's been too busy with more substantial things. Perhaps, to paraphrase the proverbial schoolboy, "The Ancient Engineers" tells you "more than you want to know" about the history of technology, but if you have any curiosity at all about the development of the practical aspects of our civilization, it's a "must." Even if you are pretty well-read on the subject, you are likely to find something new in it —in particular, the well-known de Campian point of view.

The author makes the important point that, whereas "pure" science has had its ups and downs, technology, by its very nature, has had to forge fairly steadily ahead. As the sheer numbers of human beings in population centers increased, practical means had to be found for sheltering them, feeding and watering them, protecting them from their enemies and from each other, and keeping them from wallowing waist-deep in their own wastes. Combining intuition with trial-and-error, the ancient engineers found ways of doing what had to be done. War made specialized demands, and so did religion, and the engineers worked out ways of meeting them.

Because there has always been a steadier market for the practical than for the theoretical, technology has had a smoother rise than science. Mathematical analysis of the stresses in an arch came long after there were arches, and the Romans were building concrete tenements long before anyone knew what makes concrete hard and strong — present-day street construction to the contrary. Nautical engineers had worked out some sort of practical arrangement for multiple banks of oars that the theoreticians haven't puzzled out even yet—though the result may have been more impressive than efficient, and hence more important politically than practically.

By-and-large, science fiction has failed to extrapolate or invent technologies of the future or of other worlds. "The Ancient Engineers" suggests why it is so hard to do. It's relatively easy to postulate a breakthrough in science and describe its evident consequences. It's much harder to create a technology which incorporates in itself the entire history of its society.

STAR SURGEON
by James White
Ballantine Books, New York.
No. F-709 • 1963 • 159 pp • 50¢

Here is a sequel to "Hospital Station," in which the adventures of Dr. Conway and the staff of Sector Twelve General Hospital are carried to the point of galactic war. The same ingenuity and underplayed humor that were marked in the first book, but less evident in the author's short stories, are back with us.

"Sector General," as I hope you remember, is a vast hospital suspended in space between our Galaxy and the Greater Magellanic Cloud, administered by Terrans but staffed by the most varied lot of extraterrestrial physicians, surgeons and nurses you could ever hope to encounter. Here come obstetrical cases involving babies the size of a small asteroid, or surgical problems resulting from the explosion of a planet. The previous book consisted of several linked-together episodes; this one offers one relatively minor surgical puzzle which then catapults Conway, Sector Gen-

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eral, and the Galactic Federation into a war for existence.

The puzzle comes when Conway is summoned to patch up a massive but badly battered creature, considered a god by the races of its own galaxy and a criminal cannibal by the Monitor Corps of the Federation. Having solved this one with his usual combination of insight and hard work, Conway allows the critter—a dilettante do-gooder on a planetary scale—to lure him to a world which appears to be a living museum of every possible disease and ailment to which Man is prone, or can become prone. And the solution to that one brings a prickly and belligerent empire down on the hospital, as the first step to a slugging war with the Federation. The siege of Sector General, and the medical, psychological and personal problems it generates, make up the last half of the book.

With these stories, the English author has a tiger by the tail—and it's purring.

THE GIRL, THE GOLD WATCH & EVERYTHING
by John D. MacDonald
Gold Medal Books, N.Y.
No. S-1259 • 1962 • 207 pp. • 35¢

This yarn starts like one of the author's highly professional mystery-action books, with the "ninny" hero — the term is his own, and frequently justified—stumbling along amid the ministrations of assorted people who are convinced that he has inherited the secret of his late uncle's success. Then he finds that he does indeed have that secret, and how to use it, and the action takes on a touch of Thorne Smith.

The secret is a kind of time-machine disguised as a gold watch. Rather, it is a device like Wells' "new accelerator," that plunges its holder into a red-lit limbo in which he can live an hour's time while the unaffected world passes fractions of a second. He likewise acquires the Girl, an uninhibited hillbilly nightclub singer named Bonny Lee Beaumont who meets him in bed and thereafter proves useful in other ways, not the least that of livening the action by her antics after borrowing the watch on a Miami beach.

There are other girls in passing: a sort of westernized Dragon Lady who leads the opposition and is at one point likened to a pack of Gabors, her TV-actress niece, and an underrated office drudge who has a couple of opportunities to be rated before the skulduggery is over.

The author's smooth hand with a word makes it all quite plausible and a lot of fun.

A CLOCKWORK ORANGE
by Anthony Burgess
W. W. Norton & Co., New York.
1962 • 184 pp • $3.95

The young English author of this bizarre book has been making his name with satirical comedy. Here he has changed pace with a vengeance, in the narrative of a fifteen-year-old delinquent living at some unspecified time in our future, who is "cured" of his antisocial tendencies by brutal conditioning. Young Alex tells his story with a kind of sardonic humor, but what he says and what it implies is as grim as anything in Orwell's "1984" or Fritz Leiber's little horror, "Coming Attraction."

Alex tells his story in a synthetic cant that has traces of present-day English "Teddy-Boy" slang, a few beat Americanisms, and a great deal of what seems like Slavic jargon. We are never told what this implies; whether the authoritarian government under which Alex lives is the relic of a Russian conquest of England, or whether England's teen-agers have simply adopted Russianisms as a gesture of defiance aimed at anti-Russian adult authority. Oddly, once you have grown used to it, this jargon becomes offensive only when Alex stops and explains what he means; however, you do have to let it carry you along and absorb the meanings from the context. This is no book to read in short snatches.

The teen-age world of Alex and his gang is unrelievedly evil by our standards, although it is all too like the headlines in almost any big-city newspaper. Theft, mayhem and rape are forms of idle amusement; murder is an incident. They are unwanted in a society that has no place for them and that has become accustomed to violence. Shaped by that society, they are starting to shape it as their numbers grow.

Then Alex is caught in a burglary, and rated incorrigible when he kills a homosexual in prison. He becomes a guinea pig for a new psychological treatment—a deconditioning by pure Pavlovian techniques, in which he is sated with the sights and sounds of violence and sex while he is sickened by drugs. He is turned out, cured—and unfitted to survive in a society in which violence is the norm.

There is little gadgetry here; less than in Orwell's book. What Anthony Burgess has done is meet, head on, the complaint that stories of the future show no change in human beings—that the characters act like our contemporaries rehearsing a play about the future. We can see the roots of Alex and his kind—and his society—in our own, but we shrink away from the monster who tells his simple story of ill luck and betrayal. Is he the clockwork orang we are making now? And if he is, what can we do about it?

THE WARLORD OF MARS
by Edgar Rice Burroughs
Ballantine Books, New York
No. F-711 • 1963 • 158 pp. • 50¢

This is the third of the ten Mars books, and the one which closes Burroughs' original triology and leaves John Carter as Jeddak of Jeddak, Warlord of Barsoom. The original was serialized in 1913-1914 and appeared in book form in 1919; I suppose I first read it five or six years later. At that time it seemed a let-down after the wild revelations of "Princess" and "Gods," and it still does. Burroughs was begin-

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ning to spread his wonders thinner and to settle down to the successful formula of successive escapes and captures, advances and retreats, that served him for another generation.

At the end of "Gods of Mars," Dejah Thoris of Helium, Thuvia of Ptarth—heroine of the next book in the series — and the jealous Phaidor, daughter of the deposed Chief Thern, were locked up for a Martian year in a sort of time-vault in the Temple of Issus, at the South Pole of Barsoom. The author disposes of that problem by making it all a mistake: there was a back door all the time, and after half a year the Bad Guys are about to use it, with John Carter in not quite hot pursuit. This in due course takes him to the North Pole, where remnants of a yellow race have their cities, plus a counterpart of Sindbad's gigantic shipwrecking lodestone—one that snatches aircraft out of the skies for miles around.

In his first two Barsoomian chronicles, Burroughs was still describing the bizarre wonders of an alien world with a lavishness that made the Victorian language of his people and sameness of his plots relatively unimportant. Remember, too, that the people in the popular fiction of his day did talk like that, so they were less noticeably wooden. In "Warlord," however, the wonders begin to peter out and Barsoom grows tame. Whether it is too tame for modern tastes, the current resurgence of authorized and unauthorized editions will soon tell us.

JUNKYARD PLANET
by H. Beam Piper
G. P. Putnam's Sons, New York.
1963 • 224 pp • $3.75

Although it is published as a juvenile, this is a yarn that anyone can enjoy. It's right in there with Putnam's other recent teen-age SF—Heinlein's "Starship Troopers," Blish's "The Star Dwellers," and Piper's own "Four-Day Planet." There is no writing down, and some telling ideas are put across with a subtle kind of directness.

The book has been developed from the author's *Galaxy* novelette of 1958, "Graveyard of Dreams." Poictesme is a world that has gone to seed, bemused by its own daydreams. It was colonized at the height of Man's expansion into the Galaxy, and was a military base in the civil war that developed between the Terran Federation and some of the colony worlds. War over, it became a cosmic surplus depot, living off what it could scavenge and dreaming of finding Merlin.

Merlin, the legends said, was the computer to surpass all computers, buried somewhere on Poictesme. Whoever found it would automatically get all the prizes of fairy-lore: the princess, the half-kingdom, the pot of gold, the three wishes—everything. So Conn Maxwell's neighbors passed the hat and sent him to Earth to become a computer expert, and to find out where Merlin was hidden. As the story starts he comes home to his seedy homeworld, convinced that there is no Merlin. The book tells how he and his father, a hard-headed businessman, use Poictesme's nonexistent "Grail" as the carrot to get the planet's mulish economy moving again.

Not what you'd expect of teen-age space-opera? Well, no—but nobody in his right mind underrates the ability of a teen-ager to get just the point that the author is making, and nobody in his right mind should underestimate the ability of H. Beam Piper to get that point across. He's done it too often right in the pages of this magazine.

FAIR GODS AND STONE FACES
by Constance Irwin
St. Martin's Press, New York
1963 • 346 pp. • $7.50

"Lost race" stories have lost their vogue in science fiction in the last generation, and it may be that readers of Analog no longer care very much whether Columbus really came first—after the Norse, that is. There have been several books in the past year dealing with one or another aspect of this pre-Columbian discovery of America, some as crackpot as you'd expect, some quite level-headed. This is about the best of them—and a professional archeologist said so.

Mrs. Irwin is one of those "Renaissance women" who are never mentioned with the "Renaissance men." She is a Phi Beta Kappa, a professional writer, a teacher of library science at the University of Iowa, and an amateur historian and archeologist. She knows books and how to use them, and she makes the most plausible case I have seen for early contacts between the Old World—primarily Carthage and Phoenicia—and Middle America and Peru. By clearing away the crackpot "evidence" that is flourished so wildly in many books, she brings into the open the irrevocable residue of bearded, acquiline-nosed statues and negroid figures that show up very early in those coasts of Mexico and Central America to which winds and currents would carry explorers or refugees from the Mediterranean.

Most of the book is devoted to the neglected and pooh-poohed suggestions of transatlantic contacts. Mrs. Irwin probably sent her book to the publisher before she heard of the recently uncovered evidence for contacts between very early Japan and the coast of Ecuador, or the pretty clear demonstration that Middle American traders coasted along from Guatemala to Ecuador and Peru. She has missed a point made in Geoffrey Ashe's "Land to the West"—a study of legends of Irish voyages to America before the Norse came. Ashe points out that only the first set of bearded statues need have been made from an original European bringer of wonders. Thereafter, sculptors would have established the type for the "Fair God," and the beards would continue down through the centuries.

Most important is the change in atmosphere which is taking place. Professional archeologists are now willing to look at—and look for—indications of contact between the two hemispheres. At the same time, laymen—taking Mrs. Irwin as the example—are revealing the ability to sift and evaluate evidence, which was never the exclusive property of the Ph.D.'s but was not noticeable in the books by perhaps unconscious racists, who insist that *all* that is good in the Indian cultures had to have come from Egypt or Phoenicia or Atlantis.

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continued from page 7

wolf, leaving it panting and tired behind his fleet feet, as the wolf takes in a successful chase. Or the deer must take deep satisfaction — emotional pleasure—in driving off the attacking wolf with lashing, sharp hoofs.

Remember that no deer ever has memories of being caught and killed by the wolves. Not even racial memories! They remember only the joy and satisfaction of defeating the wolves' efforts.

Orwell's world of "1984" would, with just a few hundred generations, have produced a happy, stable, comfortable society, too. Individuals like Winston, the hero of "1984," would have been culled, and the population would have been as happy and contented as the bees in a busy hive. (So the workers live only a few weeks before dying of exhaustion. So what? They like it that way! If you want to make one miserable, pen it up so it can't work itself into exhaustion.)

And then somewhere around ten thousand years ago, the happy, contented world of ritual-taboo tribes began to come apart at the seams. The selfless, state-oriented tribesmen came under the attack of a vicious, new type of human being—the barbarian, who was self-motivated, who rejected security and happiness for the uncertainty of self-willed "individual freedom."

If ever there was a "Forbidden Fruit" in a Garden of Eden—it must have had to do with the idea of being a self-willed, uncontrolled barbarian. Because the Paradise all the generations of Mankind had built started coming apart.

The essence of a stable cultural system is that a workable system is found, and then that system is rigidly maintained. "Leave it alone! It works!" and don't complain that "it might work better if we just . . ."

The barbarian clans were different —and as deadly to the monolithic totalitarian tribes as the mammals were to the great saurians. The essence of cultural stability was that it didn't change from generation to generation; it couldn't learn this year a lesson that caused it to react differently next year. The result was that a barbarian clan could attack a ritual tribe this year, and learn exactly how it responded. Next year, they could be perfectly assured that their tribal opponents would behave exactly the same. And know exactly how to destroy the tribe.

The saurians died out because, being pre-programmed from the egg, they had to *evolve* new types of behavior . . . while the mammals, being born ignorant but able to learn, could *learn* a new type of behavior, and attack in a way the saurian hadn't evolved a defense against.

So the ritual tribes went down to defeat, and the barbarian clan type of life-ways became dominant.

And, presently, a still newer type of life-way was invented—the co-operative-citizen system of the cities.

Currently, after not more than about six thousand to eight thousand years of experimenting, we're still trying to crack the problem the barbarians invented and presented to Mankind. (And Pandora's box, once opened, can't be restuffed. We can't go back.)

The barbarians had introduced the basic driving force of a *dynamic* cultural system, to replace the *static* cultural system of the ritual tribesmen. The Totalitarian State *can* be a place of happy, contented and secure citizens; it has been. It was for a long, long, time—probably twenty-five or more times the whole span of history! But it can be a happy contented place only in the way a beehive or anthill can; by breeding a type of human being who is genetically designed to fill the niches that exist in the totalitarian system.

You have most certainly—and most thoroughly! — been indoctrinated in the Wonders of the Democratic Way Of Life as the only one in which the individual can be happy and dignified.

That is strictly lying propaganda.

Democracy is a form of government which doesn't suit any human beings, and never will. Totalitarian cultural patterns did suit human beings, and they were happy. The African tribesmen today—if the barbarian invaders would just kindly drop dead—would be a very happy, laughing, contented people, precisely as their ancestors were ten thousand—one hundred thousand—years ago.

Of course, just as the ant and bee cultures mean the workers drop dead of exhaustion in a few weeks, in a ritual-tribal-totalitarian system, the people drop dead early. Their numbers are kept down by protein starvation, and they live with disease as a constant companion. (The *normal* condition in many African tribes is a sort of walking pathological laboratory specimen, with a little malaria, a little sleeping sickness, a little protein starvation, and a little of six other diseases.)

But *they are emotionally content.*

And this can result *only* from a cultural system stable long enough to breed—by selection and culling of the "good" and "bad" individuals who are permitted to mate—a human type adapted to the specific cultural system.

Obviously, a type bred to fit the culture will *like* things that way—however awful, inhuman, ghastly, degrading, or what-not terms *you* may feel should be applied.

What the barbarians introduced—and we're having hell and hallelujah with now!—is the *dynamic* culture system which does not remain stable in any form long enough for a specific

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human breed to be selected to match it.

That's why Democracy is not, and never can be, a form of government in which human beings can be happy and dignified. It will never be around long enough to breed a democratic-type population to live in it! And if it did, of course, it would then be simply a Totalitarian Stable Culture, Type D-13.

Now it is pretty darned easy to build a rocket vehicle that can stand up tall and straight on the launching pad; all that is required is that it have static stability. But to build one that will remain properly aligned while its rocket engine is thrusting it from behind with a force several times gravity . . . ? That's a completely different class of problem. That's a problem in *dynamic* stability.

You've seen these — supposedly — artistic mobiles — complicated contraptions of mis-assorted shapes hanging from a series of balanced arms. They may be called mobiles—but they're statics. Can you imagine one of those things staying together at 1800 RPM, for example?

An automobile engine's rotating assembly of crankshaft, connecting rods and pistons is at least as weird a collection of odd-shaped parts as any of the artist-designed mobiles—but it is dynamically stable. It's designed to operate at anything up to as high as 8,000 RPM and do so without excessive vibration, and definitely without showing signs of self-disassembly.

What Mankind has been trying to do, during the last six thousand years of recorded history, is to discover a system of government that produces a dynamically balanced culture.

One of the greatest problems in this effort is that the material we have to work with is derived from some two hundred fifty thousand years of careful selective breeding to produce a *static* citizen! A person with a built-in urge for stability, security, and *status quo* living that's as deep as a bird-dog's urge to hunt birds. It's like trying to pump sea water through pipes, when the temperature is about —20°C. The stuff keeps tending to crystallize and plug up the whole system, getting it thoroughly jammed into a nice, safe, static system again.

With enormous effort and great driving ambition, a group of men build a dynamic culture. Being dynamic, it rapidly grows, achieving new, phenomenally higher standards of living. It attracts people from other cultures—specifically, it attracts inherently dynamically-inclined people.

But . . . unfortunately, you can't undo two hundred fifty thousand years of selective breeding in a mere six millenniums. The driving, ambitious men beget children who, with the inevitability of genetic statistics, tend back toward the dear old *status-quo* tribal type. The dynamically-inclined immigrants produce a next generation of statistically-inclined children. The pipes begin to get clogged up with ice crystals, the dynamic system slows down, despite even greater driving power . . .

And presently the dynamically-inclined grandchildren of the pioneers are being harried, chased, suppressed, and invited to drop dead because they are trying to change a Good Thing We Have Here Now.

Man's last six millenniums has been a search for a dynamically balanced culture—and a way to keep it from getting plugged up by the ever-recurring static-directed results of the ages of totalitarianism. It's that ancient, powerful urge toward the happy, stable system that makes all the totalitarian doctrines so attractive.

Now we might sketch briefly the essential characteristics of a truly dynamic cultural system, that would produce a maximum progress of the entire human race. The interesting thing is that precisely such cultural systems have been set up, again and again. Each has shown that the system can produce enormous advancement . . . and each has fallen very shortly afterward! Because each has fallen victim to the "Let's stop here!" genes of the totalitarian ages.

Ideally, a truly dynamic cultural system would allow every individual to develop his individual potentialities to a maximum—so long as they were constructive potentials. (Unusually brilliant assassins, and remarkably imaginative sadists not needed, thanks.) The culture will award each individual—whatever his source—in proportion to his real achievement. And it will thoroughly and efficiently suppress the destructive individual, the parasite, the intransigently self-centered.

It will have to be a pragmatic system, not one dominated by theories of Good and Bad, but by systems that allow multiple parallel ideas of Good and Bad to be tested in practice against each other.

It will show no discrimination whatever on the basis of race; in its treatment of the individual—but it will show awareness that genetics isn't something Man can blithely ignore. It will respect the descendants of a line of highly able people, and "bet" that they will probably produce more. But it will allow any individual of any origin unlimited opportunity to achieve within the culture.

Such cultures have arisen, time and again. But they're too unstable to last long—because they *are* dynamic! And the people they must work with retain the old, *status-quo* genes, which, once they've achieved a comfortable position in the dynamic system, seek to

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freeze the system right there.

You can not have a dynamic system . . . and have seniority rights, guaranteed pensions, and cradle-to-grave security. Those things are intrinsic in the totalitarian static systems, not in dynamic systems.

You can't even have a guaranteed right to life or liberty in a dynamic system; the one absolutely guaranteed right is the right to *try*. But with absolutely no guarantee of success in your effort, nor any guarantee of reward for "a good try."

The dynamic system must pay attention to the dynamic laws of the Universe—if it wants to live in the Universe of reality! And the laws of the Universe require that men, like other creatures, be subject to the pressures of evolution. There must be rejection of the unfit, if acceptance of the fit is to have meaning.

Such cultural systems have been tried—and they have shown immense, dynamic achievement while they remained what they started out to be, true dynamic cultures.

And—no one today would want to live in such a culture. Such cultures are Undemocratic, and they are Tyrannical and they are Cruel and Heartless.

That's the type of culture you've read about in the Arabian Nights. A man born a slave could become Grand Wizir—and a noble of great wealth could be sold into slavery if he were a fool and lost his wealth. But a man so unlucky as to be captured in war, and sold as a slave—could become Grand Wizir again! In the Arabian Nights, there is again and again the underlying concept of the captive made a slave who pleases his master—i.e., proves to be a highly competent individual—and rises to a position of high esteem in his new country.

The Islamic Empire was one of the few human cultures that showed absolutely no race prejudice. They did have a distinct bias on the subject of creed—but anyone who was willing to accept their creed was allowed full participation. (Rather as we are willing to allow a Russian to become a full participating citizen of the United States, if he will abandon his creed and accept ours.) But Jew, Gentile, Oriental, Negro, Indian—it made no difference. All were treated alike.

Because, of course, if you judge every man on the basis of what he is, and are permitted to reject him for a fool, as an obnoxious parasite, as an intransigently self-centered type—if you are allowed full, free acceptance *and rejection* of every individual, you can afford to accept any racial type.

Any culture which holds that a man should not judge his fellow man is setting up an inherently stupid axiom. If men don't judge—who will?

Islam wasn't the only full-range dynamic culture; it is perhaps the most familiar, because of the Arabian Nights stories. But the Ottoman Empire established by Suleiman the Magnificent had many of the dynamic-culture traits.

Almost any true frontier culture will have the full-dynamic system, as did the early American culture. For one thing, a wide-open frontier allows the self-important, presumptuous fool to "show them" by going out and getting himself killed off by the frontier. And the highly competent man who discomforts his neighbors can go out to the frontier and "show them" by building an empire that proves his ideas sound.

It's not a very popular system, of course, because there is so little security.

Which is the inherent nature of any dynamic cultural system; no guarantees available! Neither life, liberty, nor happiness is considered a right, because they aren't inherent rights. The Declaration of Independence to the contrary notwithstanding, God did *not* endow us with those as inalienable rights; if He had, we wouldn't need cemeteries, jails would be impossible, and the entertainment industry unnecessary.

The *pursuit* of happiness *is* an inalienable right; that's simply the right to try.

The trouble is—those ages of totalitarian breeding make us have an urge for security, static conditions, and an all-powerful-beneficient state as strong and as irrational as a highly bred retriever's urge to retrieve birds.

It's going to take a long, long time, or an extremely high death rate, before Mankind breeds a type that's adapted to a truly dynamic society—a type that's adapted to it, *and breeds true.*

Because we're born hunters—and in a fully dynamic society, every individual must be able to enjoy both the role of hunter and hunted. That's what full, free competition means, of course—and that means insecurity as a way of life.

That human beings can enjoy such a situation, such a way of life, is perfectly obvious. It's called "adventure" when it's a not-for-real game—but the race wouldn't have produced genuine explorers who risked their necks for the fun of it if it weren't something men *do* have!

Some time in the future, there will arise a dynamic culture which has achieved a means of maintaining a dynamic stability.

It will be hated, loathed, and feared by all the rest of Mankind—as the tribal totalitarian cultures hated and dreaded the barbarians.

And it will inevitably overwhelm every other culture. As surely as the learning-mammals overwhelmed the evolving saurians. ■

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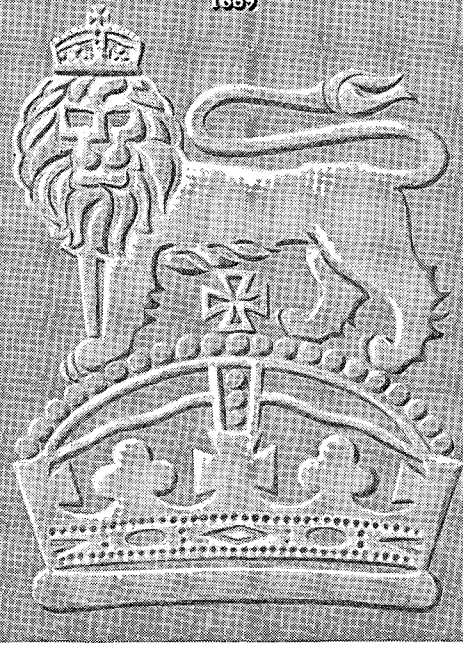

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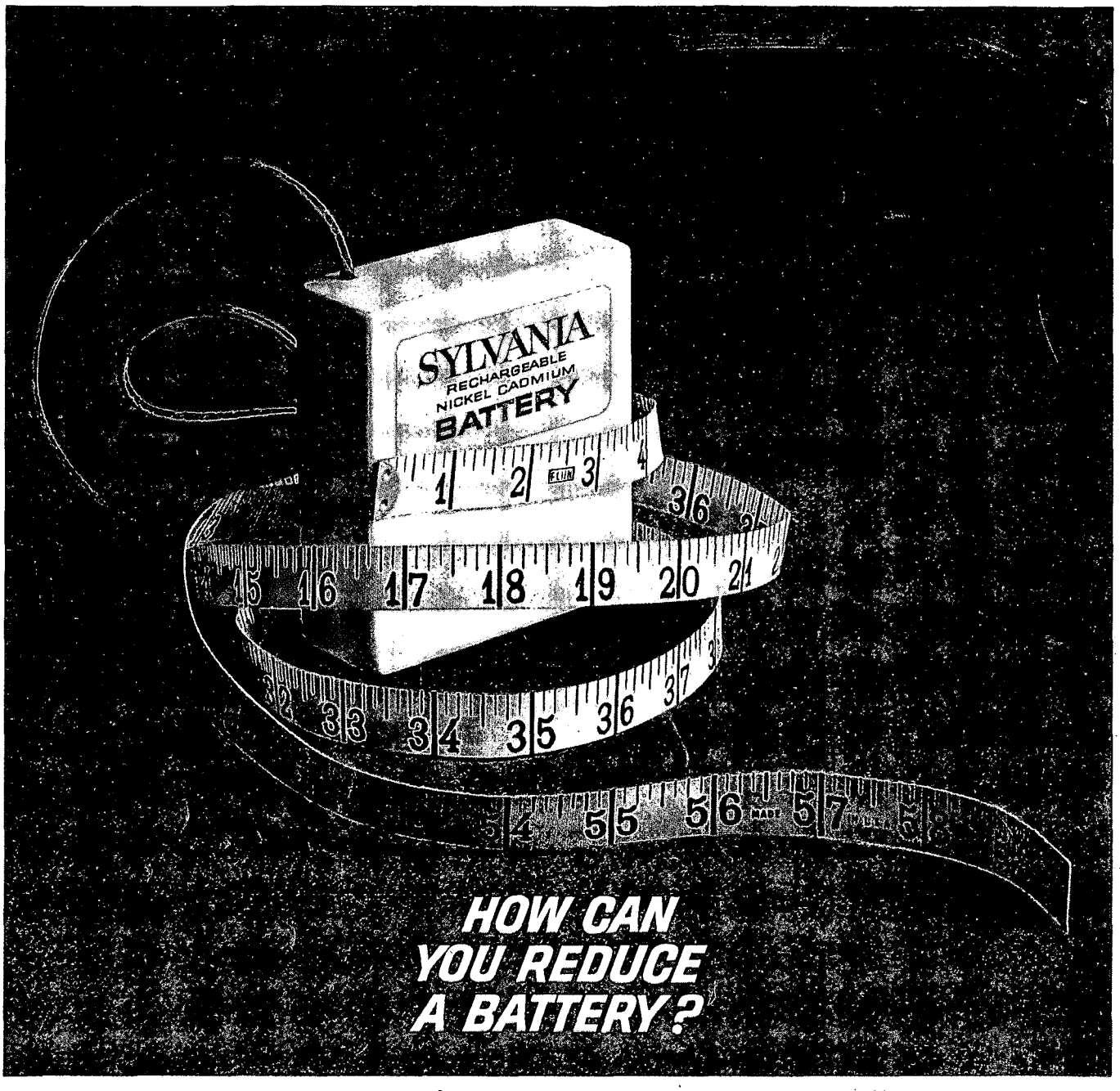

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